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FLIGHT

AIRCRAFT, SPACECRAFT, MISSILES

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The Glamour and the Gold

WHEN the traditional grouse has been dealt with at the annual S.B.A.C. Dinner (800 head or so this year), and when the cigars are nicely aglow, then silence is prayed for the President. He is heeded well, for he speaks of matters of high importance; and out of consideration for his guests—from well over a hundred nations this year—he speaks in plain terms. Generally he alludes to some particular topic of national significance. Thus, last week Sir Aubrey Burke was much concerned with airline fares and aircraft production. He said: "We are all in favour of lower airline fares because we know the surest way of getting them is by employing up-to-date methods and modern equipment. All we ask is that in this buyers' market the manufacturer is allowed to make a modest profit; otherwise he cannot afford to continue his development and probably cannot even stay in business. Manufacturers cannot survive on a diet of too much glamour and too little gold."

There is no particular glamour in the words themselves; but they should be printed in letters of gold because they express a very special wisdom—the wisdom of a man who answers for his industry as he answers for his own company. The highest technical expression of that company's wisdom will be seen some two years hence in the Airco D.H.121; and the measure of advance, even over the Comet, is that this aeroplane will carry twice the payload, 130 m.p.h. faster, using about 35 per cent less fuel—and with the same maximum weight and approximately the same range. It is being powered with turbojets (of a very special Rolls-Royce by-pass kind) to enable it to earn not so much the glamour as the gold. This it will accomplish, as Sir Aubrey intimated, by permitting lower fares.

. . . and Caviare and Elbow-Room

The wisdom of Sir Aubrey, as we remarked, is of a special sort, won from hard technical and commercial experience. But there are other kinds of sagacity that deserve attention (and in this particular instance, command it). That which we have in mind is the wisdom of Lord Brabazon of Tara, who, as guest of honour, spoke following Sir Aubrey at the S.B.A.C. Dinner. On the same twin topics of glamour and gold the incomparable "Brab" holds decided views, which he propounded at the dinner in Brabazonian character. "Cut out the caviare and smoked salmon, and give me elbow-room to blow my nose," he demanded; and there could have been few dissentients from this opinion among the company of diners. But it was not questions of alimentation and hygiene that were really exercising Lord Brabazon. He defined *his* sort of aeroplane in unequivocal negatives: "What I don't want is a machine which needs over 2,000 yards of runway; I don't want a machine that lands at 160 knots; I don't want a machine that costs over a million pounds; and I don't want one that requires acres and acres of spacious buildings and workshops to maintain it."

There were present at the dinner certain men of honesty and talent who evidently considered that this specification in reverse could hardly be met (or at least they deemed Lord Brabazon to be speaking in his more quixotic vein). But there were others who believed that the sort of aircraft he envisaged will come.

Certainly there is far more in all this than the dogmatic and sterile turbojet v. turboprop controversy—one which has been rendered so by the by-pass turbojet. And just as the by-pass engine is a compromise, so may compromise prevail in respect of airframes. That same compromise might well be one significant means of reconciling the glamour and the gold.

FROM ALL QUARTERS

The Russians Hit the Moon

APPROPRIATELY timed on the eve of the departure of the Soviet Prime Minister to the U.S.A., a Russian probe has been impacted on the face of the Moon. Apparently employing hardware similar to that which, on January 2, placed Lunik I (otherwise Mechta) in orbit round the Sun, the new device broke new ground in having mid-course guidance.

Fired at 1236 hr on Saturday, September 12, the vehicle was reported at 49,000 miles over New Guinea 24 min later. Its track was rendered visible by a sodium flare emitted after dark on the same day. The final stage—described as "a gas-filled sphere"—is reported to have weighed 3,324 lb (79 lb more than that of Lunik I) and carried some 858 lb of instruments (61 lb more). Included in this stage was a command-controlled vernier rocket system.

Throughout its flight of some 235,500 miles, the instrument container transmitted strongly on 19.993, 19.997, 20.003, 49.986 and 183.6 Mc/s. During Sunday the signal strength decreased, until after some 33 hours, when the instrument container was very near to the Moon, only the Jodrell Bank radio telescope remained in contact. At 2202 hr 24 sec all transmissions ceased abruptly, when Jodrell's giant dish was pointing squarely at the moon. This is the only independent confirmation of impact, although a Hungarian observatory claims to have detected a transient cloud of dust near the Mare Serenitatis, a "sea" towards the north-east lobe of the Moon's face as seen from the Earth, and within the area predicted by Soviet scientists. The latter had originally given 2201 as the impact time.

Impact speed was approximately 2.05 miles/sec, and there is no suggestion that any form of retro-rocket or terminal guidance was employed. This further underlines the magnitude of the Russians' achievement in effecting an accurate strike within 1¼ minutes of the predicted time. Even more remarkable is the claim that pennants emblazoned with the hammer and sickle were "preserved"—in an unstated manner—during impact with the Moon's surface.

Lunik II, the official name quoted by Tass, has thus become the first man-made cosmic vehicle to reach our nearest neighbour, and is a precursor of more sophisticated devices which in the years to come will achieve "soft" lunar landings, go into orbit around the Moon and explore several other bodies within the solar system. All such missions must be made with sterilized vehicles, and in their announcement of the launching, Moscow Radio confirmed that *Lunik II* had been rendered completely free of any terrestrial germs or micro-organisms.

In retrospect it is conceivable that *Lunik II* could have carried a timing device to cut off transmission at the predicted impact time, irrespective of whether the package hit the Moon or missed; but nothing that the Russians have done in the past lends credence to this idea. To quote Professor Lovell, Director at Jodrell Bank, "From every conceivable point of view it is quite fantastic . . . at Jodrell Bank we have learnt to have the greatest respect for announcements made by Russian scientists. The information they have given us has always been precise."

C.P.A.L.'s Britannia Repeat Order

REPORTS at the opening of the S.B.A.C. Display that Canadian Pacific Air Lines had ordered two more Britannias were confirmed last week-end. The order, to be completed in October and November, will bring to eight C.P.A.L.'s Britannia fleet.

The president of C.P.A.L., Mr. Grant McConachie, says that Britannias have been acquired "for operations on our Polar and Trans-pacific, Trans-continental and other services, because no other aircraft in the world today combines the same qualities of range, economy and airport capabilities with a speed well in advance of the types of aircraft it replaces. Passenger opinions of the Britannia have been particularly gratifying. . . ." The aircraft concerned will be Britannia 320s.

And Now the Avro 758

LAST week Mr. Krishna Menon, India's Minister of Defence, announced that the contract between the Indian Government and the Hawker Siddeley Group included an option to manufacture in India the Avro 758. This is understood to be a high wing, rear-loading variant of the 748 for the Indian Air Force.

According to A. V. Roe, the I.A.F. had always wanted a rear-loader for the parachuting and supply-dropping tasks now performed by their Dakotas, but were prepared to accept a number of low-wing aircraft because these would more nearly meet the as yet unfulfilled requirements of Indian Air Lines. An interim design of the Avro 748 also to be built for the I.A.F. will have large side-loading doors in the rear fuselage for aerial dropping.

Design of the 758 is as yet in the early stages. Gross weight will be greater than that of the 748 and the floor will be stressed for 250 lb/sq ft loading.

The S.B.A.C. Dinner

IN previous years the Flying Display Dinner of the S.B.A.C. has been held on the eve of Farnborough, but this year it was thought an improvement to let the guests see the Show first, thus giving an opportunity for discussion (and possibly for a little business, as Sir Aubrey Burke, the president, remarked).

Reference to particular points from Sir Aubrey's speech, and from that by Lord Brabazon, are made in our leading article. "This year," said Sir Aubrey, "for the first six months we were exporting at the rate of £175 million per annum and it seems certain we shall have another record year. This rate represents £3 8s per annum per head of our population, which is about 50 per cent higher than the figure of our nearest competitor. . . ." Sir Aubrey continued, "British engines are installed in more than 50 different types of foreign aircraft, and we are often asked why it is these aircraft cannot be shown at Farnborough. . . . Naturally, as a Society we are sympathetic to this point of view and the only reason we have not so far been able to permit it is because of the practical difficulty of accommodating about 50 additional aircraft in an already somewhat crowded show. However, it is a matter which we have always got in our minds. . . ."

Having summarized some of the year's major achievements, Sir Aubrey concluded, "Regarding the future growth of air travel in all its aspects for passengers, freight and agriculture, you will realize I am an optimist, and I believe we have only just begun to scratch the surface. We certainly have not done much deep digging and we have not applied enough quick-growing fertilizer. Nevertheless, I believe that in the year 2009 the president will have a thrilling account to give of the progress made in the second 50 years of aeronautical development . . . and I am equally sure that the member companies of the S.B.A.C. will have played as important a part in that development as they have done in the past."

Helicopter "Wedding Breakfast"

THE final—and very well attended—dinner of the Helicopter Association of Great Britain as a separate entity took place in London on Thursday of last week.

The toast of the Association was proposed by Mr. Peter Masefield, president of the Royal Aeronautical Society, of which body the Association is soon to become the Rotorcraft Section. The Association's president, Mr. N. E. Rowe, naturally spoke of the coming "marriage" of the two organizations, but he also took the opportunity to pay tribute to those who had contributed most to

MIGRATING to Ceylon, two D.H. Herons were handed over to the Royal Ceylon Air Force on September 10 prior to being flown out to start their new duties. Here two of the visiting contingent, who were the first R. Cey. A.F. representatives to come to the U.K. by air (in a D.H. Dove), talk to de Havilland test pilot Geoffrey Pike at Hatfield

HUNTING SHORT-HAULER: Seen at the Show was this model of the H.107 (two Bristol Siddeley Orpheus), Hunting Aircraft's 48-seat airliner project noted in our Display report last week

NOW AIRBORNE (flown for this picture by Mr. B. Goodchild) is Mr. J. Taylor's home-built ultra-light, with a 36 h.p. J.A.P. engine

the Helicopter Association during its relatively short life. It was significant that the original list of founders were all pilots. "They had seen the chance to do things [with aircraft] that could never be done before," he said. Mr. Rowe also read a happily phrased message of greeting from Mr. Rolf P. Alex of the American Helicopter Society.

Sir George Gardner, Director of the Royal Aircraft Establishment and Controller of Aircraft designate, replied for the guests.

When the amalgamation has been achieved, and subject to royal assent, the R.Ae.S. is likely to acquire the new full title "The Royal Aeronautical Society, with which is incorporated the Helicopter Association of Great Britain."

A.S.S.E.T. Pamphleteering

IN a pamphlet published last week under the title *Air Policy 1960* the Association of Supervisory Staffs, Executives and Technicians expresses the view that Britain's aircraft industry "is in confusion" and suggests several remedies. These include the development of a medium-range Mach 2-3 airliner, cutting-back of missile production, an enhanced programme at research establishments, Government credits to help to finance orders from overseas (a suggestion also made by Sir Aubrey Burke, president of the S.B.A.C., at the conclusion of last week's Farnborough display), and planning by B.O.A.C. and B.E.A. of their future requirements in close consultation with manufacturers. A.S.S.E.T. also suggests that the case for turning leading aircraft companies into public corporations "is now overwhelming."

The pamphlet bears the signature of the Association's national officer, Mr. Clive Jenkins. On the premise that "there is not one major British aircraft now in production which is backed by a good-enough order-book," the author goes on to speak of an "unplanned reduction in the size of an important highly skilled industry with an uncertain financial basis." He criticizes "the golden flow of public money into the aircraft companies," which (he alleges) have "gambled on leap-frogging over 'generations' of engines and airframes." He also underlines the strength of American competition, with the military development of civil aircraft and attractive "package-deals" for buyers; and considers that West German competition will have become formidable by the late 1960s.

The pamphlet suggests that compensation—on the basis of one month's pay for each year of service—should be paid to workers declared redundant in the aircraft industry.

Meanwhile, negotiations between B.O.A.C. and the engineering unions to improve efficiency appear to be deadlocked, at least so far as A.S.S.E.T. is concerned. Another of the Association's recent pamphlets says that "to attempt to impose a method of re-organization, to abrogate trade union agreements, clearly demonstrates that consultation, co-operation and teamwork are lacking." Setting out minutes of negotiations with B.O.A.C. going back to 1951, A.S.S.E.T. maintains that "job groupings" contractually agreed cannot be modified unilaterally.

IN BRIEF

A.V-M. A. Earle, at present A.O.C. No. 13 Group, is to be Deputy Chief of the Defence Staff from next January with the acting rank of air marshal. He succeeds Lt-Gen. Sir Roderick McLeod.

Mr. Robert Broadbent, managing director of the Sperry Gyroscope Co. Ltd., has been appointed chairman of the board.

Vanguards under construction for B.E.A. are being equipped with the new lightweight Ekco search radar (described on page 265).

The Indian Government has decided to equip the country's Naval air arm with A.W.A. Sea Hawks. This was announced by the Deputy Minister of Defence, Mr. K. Raghuramiah, on September 12.

Air Marshal Sir Edmund Hudleston, Vice-Chief of the Air Staff, is to open the sixth annual exhibition of the Society of Aviation Artists next Tuesday (September 22) at the Guildhall Art Gallery, London, E.C.2. This year's exhibition, which is open daily (except Sundays) until October 10, includes a special R.A.F. section with paintings by members of Commands at home and overseas.

INTERNATIONAL AGRICULTURAL AVIATION CONFERENCE

TODAY is the last day of a four-day International Conference held at the College of Aeronautics, Cranfield, and organized by the Ministry of Agriculture, Fisheries and Food to discuss technical problems in the field of agricultural aviation. This final day is being marked by demonstrations on an international scale of agricultural aircraft and helicopters, including a Piper Pawnee, Brantly and Kolibrie helicopters and an Omnipol L.60 Brigadyr, all of which will be making their first spraying and dropping demonstrations in this country.

The display will start with a private showing for delegates in the morning and will be repeated publicly at 2.30 p.m., for which purpose Cranfield is to be open to spectators from noon onwards.

The conference was opened by Lord Netherthorpe, president of the National Farmers' Union, last Tuesday, and this and the two following days were set aside for the reading and discussion of a dozen papers on the operational, safety and agronomic aspects of agricultural flying. The conference is to be attended by about 250 delegates from 25 countries. It is being held at the request of the European Agricultural Aviation Centre and is the first gathering of its kind in Europe.

Following the inaugural paper read by Sir Miles Thomas, other papers to be given were *Agronomic Requirements* (R. C. Amsden, Chesterford Park Research Station); *Review of Materials Intended for Aerial Application and their Properties* (Dr. J. K. Eaton, Woodstock Agricultural Research Station); *The Problem of Distribution: the Physics of Falling Droplets and Particles. The Drift Hazard* (D. Yeo, read by Dr. A. B. Hadaway); *Aircraft: The Operator's Requirements* (J. E. Harper, Fison-Airwork Ltd.); *Distribution Equipment* (R. F. Hill, Colonial Pesticides Research Unit); *International Airworthiness Standards in Agricultural Aircraft* (H. G. Winton, Air Registration Board); *Corrosion Problems in Airframes* (F. C. Porter, Aluminium Development Corporation); *Economic Factors Affecting Agricultural Aircraft Operations* (N. D. Norman, Crop Culture [Aerial] Ltd.); *Safety Precautions* (Dr. E. F. Edson, Chesterford Park Research Station); *Techniques of Low Flying and Flight Safety;* and *Ground Organization*—(1) *The Pilot's View,* (2) *The Ground Operator's View* (M. Bradford, National Association of Corn and Agricultural Merchants).

In his opening paper, *A Review of the Developments in Agricultural Aviation*, Sir Miles Thomas first briefly examined the historical background to aerial farming which, he said, began almost half a century ago, although in Britain it did not get under way until after the Second World War, and then mostly with adapted Tiger Moths. Today there were 13 operators and 40 to 50 aircraft in use, most of them still of war-time or pre-war vintage.

In one respect Britain could claim to be a world leader. This was in the use of the helicopter for crop spraying and other agricultural duties. Although it had not yet become popular (because of its high first cost) the helicopter could double the number of areas treated per hour and gave effective cover, spraying as little as five gallons per acre. Following Pest Control's lead, Fison-Airwork had now sprayed 1¼m acres in many parts of the world and B.E.A. with their converted Whirlwind were spraying the widest swath—23ft—anywhere.

The Russians were actively engaged in crop spraying, said Sir Miles, and in Iran last year operated 12 aircraft—free of charge—to clear a locust plague. It was known that they had at least four predominantly agricultural aircraft in production which compared favourably with similar machines of British and American origin, and several war-time airfields had been reorganized as operational bases for agricultural aircraft working in considerable numbers.

In America, experimental work was being done to investigate the possibilities of top-dressing steep, stony acres which could then be used as grazing land, and at least two colleges were running concentrated training courses for agricultural flying—which called for great application and skill.

The greatest future use of aerial farming, Sir Miles concluded, was to improve farm productivity and to increase food production for a rapidly growing world population. This would not come about by itself and there might be a case for a Ministry grant or guarantee to encourage aerial farming operators. There was a need for better chemicals for low volume, high-speed application, safer aircraft with bigger payloads, wider dispersal swaths and application techniques that did a better job of getting chemicals where they were needed. Finally, agricultural aviation must create a good and true image of its activities in the public understanding.

AIR COMMERCE

PAN-COMMONWEALTH AIRLINES?

RECENT press reports have referred to a proposed union of British Commonwealth airlines. On September 5, following some particularly big black headlines, a Ministry of Transport spokesman said (according to Reuter) that a "definite objective" of British Government policy was a "link-up" of Commonwealth airlines.

Since the early part of this year (*Flight*, January 23) talks between Air-India and B.O.A.C. and their respective governments have been directed towards a revenue pool agreement. Qantas, with whom B.O.A.C. are in pool in a Kangaroo partnership extending back 25 years, have been "kept fully informed."

So far no Air-India - B.O.A.C. pool has been agreed; but Government talks in London from August 19 to September 9 took place, according to a Ministry statement of September 10, "against the background that [B.O.A.C. and Air-India] will be meeting again during November to consider possible pooling arrangements . . ."

A further inter-governmental meeting would take place in New Delhi in January, 1960. On the very same day (September 10), Mr. Gordon McGregor, president of Trans-Canada Air Lines, forecast the possibility of a T.C.A. - B.O.A.C. pool on the North Atlantic next spring. He was referring to "speculation about a Commonwealth organization similar to Air Union," and he told the Canadian Chamber of Commerce in London that "some conversations had been held between Commonwealth airlines with a view to realizing at least some of the economies which could be obtained from closer collaboration."

From reports that there have also been high level talks between the Indians and the Australians it becomes possible to deduce that quadripartite pool partnership among the four Commonwealth airlines has, indeed, been discussed.

A glance at the international networks of the four airlines concerned—B.O.A.C., Air-India, Qantas, T.C.A.—suggests that such a pool could result in formidable Commonwealth influence over the world's international routes. So far as can be judged, nothing deeper than a pool agreement is being considered as a first objective. Thus comparisons with Air Union, whose members are going all the way on integration (as S.A.S. did ten years ago) are misleading. But Air Union is influencing the present discussions—particularly so since the strong reports that Japan Air Lines wants to become a member of the European airline club. If that ever happened the balance of power on the routes between Europe and the Far East—and indeed across the Pacific—might well shift.

A Commonwealth quadripartite pool would align economic policies, and it could conceivably lead to a rationalization of maintenance and equipment, *à la* Air Union and S.A.S./Swissair. There have already been reports that Qantas and Air-India might order Comet 4s; technically this might be logical, but British protagonists of the Commonwealth airline idea would obviously not want it to be thought that they are motivated by a desire to sell British aircraft.

The idea of a pan-Commonwealth airline network encircling and collectively influencing the U.S.-dominated world of air transport may seem a little far-fetched at the moment. But so, less than a year ago, did the idea of Air Union.

A HELICOPTER AIRLINE FOR BRITAIN?

APPLICATIONS have been placed before the Air Transport Advisory Council by Inter-City Airways Ltd., a new operating associate of Rotorports Ltd., for licences to operate helicopter services within the United Kingdom and to Europe. Four scheduled services are proposed: (1) between London Airport, central London and Southend Airport; (2) between Hendon Airport, central London and Gatwick Airport; (3) between central London, Portsmouth, Ryde, Cowes and Southampton; and (4) between central London, Birmingham and Manchester.

Whether and when Inter-City Airways will ever become operational—Rotorports say it could do so within two to three years—depends upon Government permission for Rotorports' proposed central London heliport at Nine Elms Lane, Battersea, about 700 yards south-west of Vauxhall Bridge.

The proposal to construct a permanent heliport on this site was rejected in June by the Minister of Housing and Local Government, Mr. Henry Brooke, on the grounds that the value of a second heliport in London would not justify the disturbance to nearby residential areas. Mr. Brooke was endorsing the argument put forward by the Westminster City Council, whose opinion was that no site for a helicopter station would disturb more people than the proposed site; and the benefit to those using the services it offered would be outweighed by inconvenience to the 35,000 people who live nearby. This was in spite of Rotorports' case that the existing noise level on the Embankment was such that telephone conversations were difficult up to fourth-floor level and that the noise of a helicopter would be no greater than that of trains crossing the bridge to Victoria station.

No firm decision has been made by Inter-City Airways as to the type of equipment they would operate. They say that they are particularly interested in a developed version of the Fairey Rotodyne and the proposed civil version of the Bristol 192. The civil Vertol 107 is also under consideration.

Directors of Inter-City Airways (and also of Rotorports) are Lord Morris of Kenwood, chairman; Capt. John Crewdson, managing director; R. Rodway; Nigel Wallis and Henry M. Berney.

SUPERSONIC SPECULATION—1

REPORTS last week that Bristol Aircraft and the Hawker Siddeley Group are to co-operate in the building of the British supersonic airliner have been officially described as "premature." No Ministry of Supply tender or design contract has been put out to the industry, and in fact there seems to be no change in the supersonic airliner situation.

To recapitulate briefly: in November 1956 the Ministry of Supply appointed a Supersonic Air Transport Committee comprising representatives of the industry under the chairmanship of the R.A.E. The report of this committee was given to the Minister five months ago (*Flight*, April 24). The proposals were that two types of airliner should be developed—a medium-range airliner of Mach 1.2, and a long-range type of Mach 1.8-2.0. These proposals were heavily criticized as being commercially unrealistic in the light of American competition, and firms were then asked individually for their opinions.

The fact that any British supersonic airliner will have to be tackled by a consortium of firms has never been in doubt, but recent reports suggest that the possibility of an M.o.S. design contract (reported to be worth £½m) has stimulated the interest of the following industrial groupings: (1) Bristol-Hawker Siddeley; (2) Airco (de Havilland, Fairey, Hunting); and (3) Vickers - English Electric.

SUPERSONIC SPECULATION—2

THE above recalls the suggestion that Britain should work with America on a supersonic transport which was recently made in London by Mr. Peter Masefield, managing director of Bristol Aircraft. Delivering the first Wakefield Memorial lecture of the College of Aeronautical and Automobile Engineering on the subject of *Our Place in Aeronautics in a Supersonic World*, Mr. Masefield said: "We have come to a time now where I believe that this is feasible. I believe that any such collaboration would have to be started on a government-to-government level and carried through as a company-to-company task. Along that road many tens of millions of pounds could be saved."

One of the great decisions to be faced in this country "in the next short while" was whether we were to remain in the Big League of supersonic transports, flying at Mach 3.5 at 15 miles above the Earth and costing perhaps £10 million each; or to be content with the more prosaic subsonic types in the Second League. In the speaker's opinion, in addition to collaborating with the U.S.A. on the first, we should go all out on our own on the second (see "The Great Divide" on page 243).

SUPERSONIC SPECULATION—3

"A GOOD personal relationship exists between these two companies. J. H. Kindelberger, chairman of North American Aviation, and William M. Allen, president of Boeing, speak the same language." This comment, appearing in the American

Here is the full-scale mock-up of the Avro 748's fuselage displayed at Farnborough, and described last week. Skyways have signed a provisional order for three, for service in the summer of 1961. Another purchase has been announced: B.K.S. have ordered two with an option on three for delivery early in 1961

The first of K.L.M.'s 12 Electras, which are due to enter passenger service in December, displays the company's new markings—a distinctive tail in two-tone blue and the omission of the words "Flying Dutchman" on the fuselage

AIR COMMERCE . . .

press, suggests that the two companies may work together in the design of a supersonic jet transport.

The remark is obviously speculative, but it is a fact that such a combination of companies, which is already producing the B-70 Mach 3 bomber (a North American design, the wing of which is being made by Boeing) would be a formidable challenger in the supersonic air transport field.

Mr. F. A. Payne, of the Los Angeles division of North American, said recently that Mach 3 jet transports carrying 100-200 passengers were "feasible, desirable and possible—even inevitable—with presently foreseeable art." Such a transport would, he predicted, weigh more than 300,000 lb, would operate at costs "competitive" with current jet transports, and would be "possible" by 1964-1966. The major issue, added Mr. Payne, was the accuracy of operating-cost estimates.

THE "GREAT DIVIDE"

WRITING in the American magazine *Airlift*, Mr. Peter Masefield, managing director of Bristol Aircraft, asks why no one has ever asked an aircraft builder for the "most economical" transport.

He contends that the die is cast for the supersonic commercial transport, and that "no one can now doubt" that such aircraft will be in service before 1970. But he suggests that supersonics will bring air transport to what he terms the "great divide."

In one direction, he argues, "we shall see speeds climbing relentlessly upwards, inevitably associated with higher operational costs, while in the other direction, if we set our minds to the task by pegging speeds at today's levels, we shall be able to bring about a dramatic reduction in the fares."

He believes that the airlines have now come to the serious business of "housekeeping on a budget" and that the honeymoon period for air transport is over. The fan jet may well "save the bacon" of present jet aircraft, but he does not think that these engines are likely to make a major contribution to those reductions in operational costs which are so essential if we are to see fares reduced substantially.

"Up to now," he says, "manufacturers have never been asked specifically to produce the most economical aeroplane which the state of the art can provide." The emphasis had always been on speed, which had gone up 500 per cent over the years, while advances in specific costs had come about almost entirely from increases in the scale of aircraft rather than from basic improvements in operating economics.

Mr. Masefield concludes with the thought that the technology at our disposal can produce an aircraft not only capable of flying at 2,300 m.p.h., but at 500 m.p.h. at half today's costs. "I emphasize again, however, that we have never yet been asked by airlines to do this. I hope that we shall be."

QANTAS SHOWS OFF ITS JET

THOUGH the recent demonstration of Qantas' fifth Boeing 707 (VH-EBE, *City of Perth*, Capt. M. Bamman) at London was primarily a goodwill gesture, with little opportunity during quick hops to Shannon and back for a technical or operational assessment to be made, certain impressions of *Flight*'s third flight in a 707 are worth recording.

The size and spaciousness of the 707's interior is, for those accustomed to Comet (or even Britannia) travel, immediately compelling. The Qantas cabin crew had no trouble dispensing refreshments to guests who were chatting in groups in the aisles, or wandering back and forth examining the attractive interior. Styling of this 707 successfully achieves the difficult balance between dullness and fussy over-colouring and decoration (a feature of certain recent "jet age decor," notably B.E.A.'s Vanguards and Continental's Viscounts).

The public address system was of a higher fidelity than that in the Caravelle, which is probably the best yet, and the only criticism was of the smallness of the windows—smaller, even if more plentiful, than in any other airliner. We liked the three-quarter-height partition, which did not interrupt the view down the cabin; and individual air louvres did not hiss when open, as so frequently is the case.

Our take-off was at 185,250 lb (considerably less than the 248,000 lb maximum), and the climb-away was impressive, though not so spectacular as that of the Comet, whose rotation and climb-away have caused astonishment among the most experienced passengers. Rotation speed used by Qantas is generally about 10 kt less than V_2, respective figures for our take-off into a 12 kt wind and a 20 deg C temperature being 129 kt and 142 kt (V_1 was 125 kt). We used 6,050ft of runway 10R's 9,570ft, and were at least 1,000ft high over the B.O.A.C. base at the end of the runway. It took us 35 sec to reach V_R; flaps went up to 20 deg at 152 kt, and were retracted fully at 172 kt.

Cabin noise level was excellent, if not so good—even right up front—as in the Caravelle. It is quite possible to converse in a normal voice in the long section aft of the wings and jet pipes, which is not the case in the Comet. Up front, cruising at 22,480ft (we were held down by traffic) at 340 kt and M=0.74, we noticed that r.p.m. were indicated, as per standard American practice, in percentages—110 per cent for a wet take-off, 96 per cent for max. continuous climb, 90 per cent for cruise.

Qantas are giving every 707 pilot (three per 707, plus navigator and engineer) between 13 and 17 hours' familiarization flying, about 30 hours over a minimum of six route sectors, and a final handling check (including two-engine landings). There is also a Link simulator at Sydney. The skipper said that Qantas crews all liked the 707 very much, and had complete confidence in it.

BREVITIES

L.A.V. has requested authority to buy six new Viscounts and to lease three Boeing 707s from Varig.

* * *

Overseas Aviation have opened offices in Manchester. Aircraft will be based at Manchester Airport and will be available for charter work.

* * *

B.W.I.A.'s application to extend its services to New York and across the Atlantic to London have been approved by a C.A.B. examiner, although not yet approved by the Board and by President Eisenhower.

* * *

A D.H. Heron has been ordered by Sheikh Abdulla al Mubarak al Sabah, Deputy Ruler of Kuwait, and an order for two Doves has been placed by Force Publique, the security force of the Belgian Congo.

* * *

The Harlow Development Corporation have granted Helicopter Services Ltd. of London and Luton a concession to operate charter services from Harlow.

* * *

B.E.A. has agreed to house the Nash Collection of historic aircraft in the new extension to its London Airport engineering base until next summer.

* * *

Air-India is to have three L.1049 Super Gs converted from passenger to convertible all-cargo/passenger configuration by Lockheed Aircraft Services at Ontario, California.

* * *

"Economy" Comets operating B.O.A.C.'s New York service are equipped with 48 economy and 20 de luxe seats, or as an alternative arrangement 24 first-class and 48 economy-class seats.

* * *

Air Jordan, the management of which is contracted to Transocean Air Lines of Oakland, California, is to inaugurate a weekly non-stop Amman - Rome service in October.

* * *

On Aerolineas Argentinas' route to North America the load factor has risen from 49 to 86 per cent since the Comet 4 was introduced. There has also been a rise in load factor of 6 per cent on the European route.

* * *

All-cargo services from London to New York are to be operated twice weekly by T.W.A. from October 6. T.W.A. also announce that it will start transatlantic services between New York and London with its Boeing 707-331s on November 23.

* * *

The City of London College are running evening courses on air transport law and economics and on air transport operation. Enrolment for the next series takes place on September 22 and 23 at Moorgate, London, E.C.2.

* * *

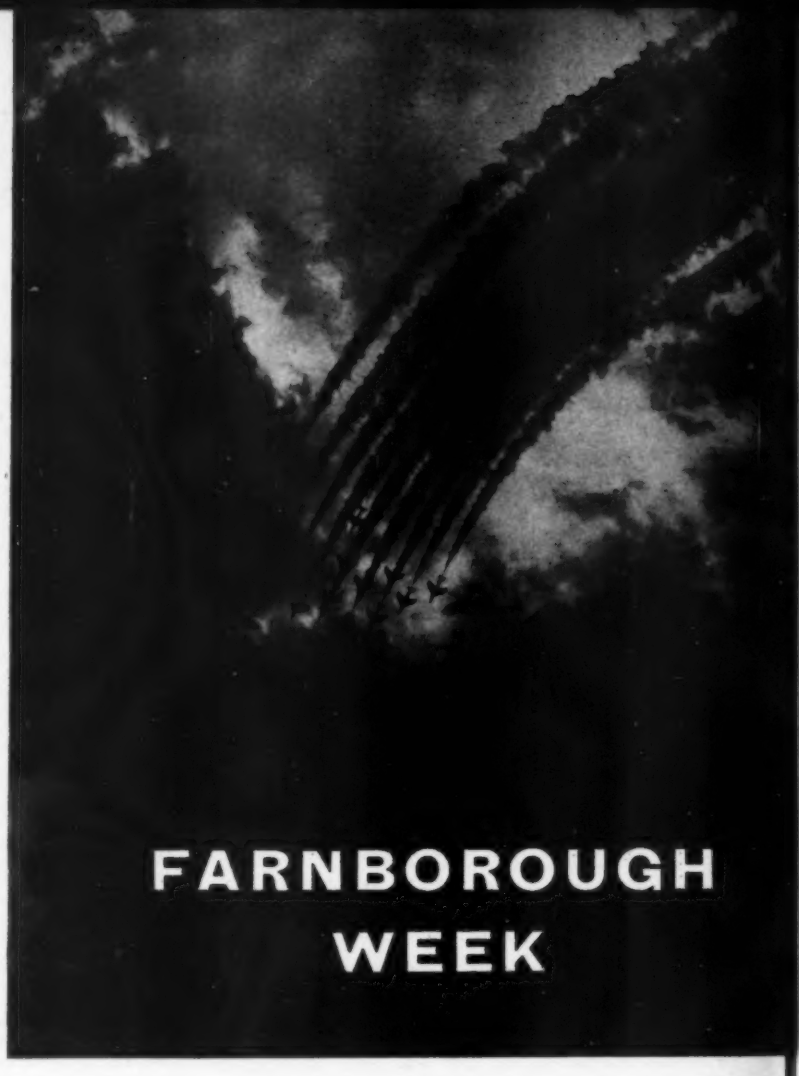
Protea Airlines (formerly Volkslugdiens), a new South African air charter company, has started operations with a Viking acquired from Trek. It has authority to operate charter flights to Saudi Arabia, Israel and throughout Africa. A decision is waited on an application to operate services for non-Europeans in South Africa and to the Middle East.

SEVEN DAYS' SUNSHINE FOR THE GREAT SHOW

ILLUSTRATED MAINLY WITH "FLIGHT" PHOTOGRAPHS

FARNBOROUGH '59—to use a convenient colloquial title for this year's S.B.A.C. Flying Display and Exhibition—will perhaps chiefly be remembered for the magnificently fine conditions in which it was held: days of cloudless blue skies and hot sunshine, with temperatures up into the 80s and the only real weather hazard (as far as flying was concerned) a haze lying over the surrounding countryside. Secondly, the attendance—especially on the public days—went up to splendid proportions: a total of nearly a quarter of a million people came on the Friday, Saturday and Sunday; and had the Show not been televised the attendance at the weekend might have created a record. On the trade days, too, attendance was of most encouraging proportions—more than 100,000 visitors coming, with 8,000 from overseas. Sir Aubrey Burke, president of the S.B.A.C., stressed on the final day the need for Government underwriting of aircraft which looked like obvious winners, and for credit to be more readily available to foreign buyers.

Certainly the industry has had something new to display both in terms of commercial aircraft and technical developments: the Comet 4B, Vanguard, Argosy and Dart-Herald all made impressive debuts; and the SR-N1 and SC.1 (although, unfortunately, the latter flew once only) showed that new forms of flight have become practicable and in their different ways must have impressed both foreign visitors and the British public. The guided-weapons park, too, gave evidence of progress in the missiles field: nothing quite so spectacular as the moon rocket and Russia's "direct hit" at the end of the week, but proof of British and Commonwealth activity in this field.



The Trade Days

Tuesday, September 8 An attractive young lady directed a bright smile at the TV camera from the cockpit of the Hovercraft and delivered a message in Italian to the waiting microphone. A re-take was necessary, however, as the sun burned through the early-morning haze at that moment and threw some cockpit-top shadows where the cameraman didn't want them. But his abrupt curses were not echoed by the other people present, who seemed to agree that a trade-day Tuesday had every right to be sunny and warm.

In the exhibition tent, also, it was warming up steadily. On the Saunders-Roe stand a control-line model of an advanced Hovercraft, powered by an electric-drill motor, whined around interminable circuits at a height of about half-an-inch, hopping over a copy of *Flight's* aircraft industry issue to show it could take obstacles in its slide.

Probably the coolest group in the tent comprised the 17 men whose helmeted and head setted faces stared calmly out from the shelves of the Amplivox stand. The warmest person could well have been Dorothy Meindok, the 1909-clad saleslady on the Handley Page stand, who sat behind an advertisement for £275 monoplanes which explained that "the covered-in body eliminates resistance and protects the aviator. . . ."

Film presentations seemed to have caught on this year, as loitering groups peered into dozens of back-projection boxes which showed companies' products variously flying, being built, being fired at targets and being taken to pieces. Here and there several of these film shows were very close together, and one's attention was distracted by the urgent taped tones of rival commentaries. Just outside the tent, in the missile park, the Vickers Vigilant film spoke with an American accent, but with a British pronunciation of "missile."

Among a variety of other attention-claiming devices were a string of bright orange barrage balloons (M.L. Aviation) which turned out to represent a nuclear device suspended for mid-air explosion; a steady one-second metronome click from a spark ignition unit (Lucas-Rotax); and what looked like a fairground game of chance involving spinning coloured balls (Reynolds T.I. Aluminium) labelled "This is the aluminium atom. A miniature solar system in perpetual motion . . . !"

Tuesday's flying display included the Conway Vulcan (not seen on Monday), which flew over towards the end of a six-hour engine-development sortie as part of its intensive flying programme from Great Hucknall. The Canberra PR.9 was present but did not fly, and starter trouble prevented the Vanguard from participating. Treble-One's Hunter performance was once again superb, while the Navy's contribution was polished in the air and restrained in commentary.

On the Monday, we recalled, the Scimitar formation had been unlucky enough to lose their leader, Lt-Cdr. Keith Leppard, whose aircraft was unserviceable, and were led by Lt. Paul Perks, with spare man Sub-Lt. Ian Aitchison in the box. Monday's star Naval performer was in fact Cdr. Price, the commentator, who gave a brash, rapid-fire presentation which included several outrageous gags. Tuesday's toned-down version was the duller without them.

During the day an Indian Government order for two squadrons of Armstrong Whitworth Sea Hawks was announced, and it was stated that "well over 500" had been produced to date. The same evening the Short SC.1 was brought into Farnborough from R.A.E. Bedford by Tom Brooke-Smith. It was flown as a conventional aircraft on the power of the single propulsion RB.108.

Wednesday, September 9 Today's flying programme began with the noisy debut of the Canberra PR.9 flown by A. F. C. Roberts, and continued with the same mixture of novelty, spectacle and plain honest interest as on previous days. Once more the R.A.F. Hunters were impeccable, seemingly producing an extra dimension from somewhere to use in their formation patterns. Once more the Hovercraft amazed, sliding along the runway like—well, like a Hovercraft, although attempts at simile have included a cup and saucer, a flat beetle, and commentator Oliver Stewart's "sea-

side bandstand" (Tuesday) and "director's inkpot" (Wednesday).

For the second successive year some were disappointed at the absence of pilots' names in the display commentary—a criticism not of Oliver Stewart but of the S.B.A.C. itself. According to this philosophy, for example, we had just watched "a most pleasant display *by the Aiglet*." But it was perhaps of some relevance that Ranald Porteous happened to be sitting in the cockpit at the time. . . . The Navy was now performing its LABS run in the opposite direction to that of Monday—but the bomb-burst stayed right were it was.

Near the end of the main runway, towards Laffan's Plain, *Flight* was on hand to watch the preparations for the demonstration of the Short SC.1, which today was to form the final item on the programme. Hidden by trees from the enclosures, a special platform had been erected in a clearing by the Army for this purpose, but there had been insufficient time for a trial take-off to be made before the actual demonstration. Around the machine waited the company's maintenance and flight development men from Bedford, in white overalls and white shirtsleeves. On the platform the pilot, Tom Brooke-Smith, hot in his shiny new blue flying suit, was talking with Short directors Hugh Conway and David Keith-Lucas. Nearby were a sprinkling of private cars, fire-tender and crane, and the B.B.C. camera crew's Humber.

The aircraft itself incorporated a fringe of ram-air intake gills on top of the fuselage at the forward end of the lift-engine bay, and a cluster of thermocouples around the lift-engine jetpipes beneath the fuselage. The jetpipe scuttles illustrated in Gordon Horner's sketch in *Flight* last week (the first illustration of the SC.1 in its new form) had been removed.

With Brooke-Smith in the cockpit and ready to go, the propulsion engine (Rolls-Royce RB.108) was started first, after which air was bled from it to start the four RB.108s used for vertical lift. Chocks were removed, the undercarriage oleos lengthened as lift-power was increased, and the machine rose vertically into a brown cloud of dust, earth and grass blown up by the four tons of very hot thrust from the lift engines.

The aircraft moved forward slowly, still carrying its own miniature dust-storm, towards the runway. Then, after covering only 200 yards, it made an abrupt landing. On reaching the machine we saw what appeared to be a rug of coco-nut matting fixed on top of the main lift-engine intake grille above the fuselage. Hugh Conway was the first to realize what had happened—freshly cut grass had been blown up from the ground and, carried by the re-circulating air, had jammed in a solid mass completely covering the intake mesh. "This is one we *didn't* think of," he commented.

Obviously this was a problem which would have been encountered and dealt with had there been time for just one trial take-off before the actual attempted display. Although no official comment was made it is believed that the pressure to rush the SC.1 into an appearance at Farnborough came not so much from the company as from the Ministry of Supply.

Three reasons why Farnborough '59 will be especially remembered: opposite, the transcendent flying of No. 111 Squadron, Royal Air Force; below, the cross-over landing by Scimitars of No. 807 Squadron, Royal Navy; right, the SR-N1 Hovercraft—astonishing, promising, unique, British

The transition trials of the SC.1 at R.A.E. Bedford had been held up by the problem of nose-up pitching when flying in the speed range of 90-120 kt with lift engines running. This effect was greater than had initially been anticipated from wind-tunnel tests (although more-recent wind-tunnel tests had given a warning indication of the problem), and the solution was believed to be to increase the available elevator angle. This modification had not yet been made, and therefore it was not planned to demonstrate transition at the S.B.A.C. show.

Tom Brooke-Smith disclosed at Farnborough that the speed range from zero to 30 kt had been fully investigated at Bedford, and that, from the upper end of the scale, performance was fully satisfactory down to 120 kt. In the gap between 30 and 120 kt he had on occasion flown up to 70 kt and down to 90 kt.

Although not mentioned by the company, the problem of the recirculation of hot air into the lift-engine intakes when the aircraft is hovering near the ground must also be a basic problem—whether or not the air contains freshly cut grass. Uneven temperature distributions across the lift-engine intakes could conceivably cause a flame-out under certain conditions.

Aircraft orders announced on Wednesday included the first executive Viscount 810—to Tennessee Gas Transmission Company; and two Avro 748s for B.K.S. Air Transport. English Electric announced its new missile for the Army (reported in *Flight* last week); and news was given of Hovercraft developments. Mr. D. Hennessey, deputy managing director of the National Research and Development Corporation, and chairman of Hovercraft Developments Ltd., said that he would be visiting the U.S.A. soon with Mr. Christopher Cockerell, inventor of the Hovercraft,

Roy Bradley enjoyed his usual Farnborough romp in the Westland Wessex (left), and Saunders-Roe had the Mk 2 version of their P.531, with Blackburn A.129 turbine, in the same circus

Farnborough Week . . .

and Mr. Ronald Shaw, Assistant Director for Aircraft Research, Ministry of Supply, to talk to representatives of companies working on air-riding vehicles. Meanwhile, development of a larger Hovercraft would continue.

Thursday, September 10 The hot, hazy weather continued and the well-wined occupants of the terrace enclosures baked gently in the sun as they watched the flying display. High in the dusty blue sky nine pairs of white eyes blinked open at us from the top of a loop—the roundels of Treble-One's Hunters, in voodoo, in the accustomed groove.

Racking turns by the Lightning T.4 (with Roland Beamont in the cockpit); and a re-shuffled programme that puts on the Hunter 66A and its smoking corkscrew (and Bill Bedford, who is in the cockpit) as the final item. The only inadvertent happening is that the Bristol 192 is slightly clumsy in depositing its Bloodhound on the ground—but an R.A.E. crane is soon on the spot to set the missile right.

Throughout the day the strange shapes in the outdoor equipment park are the subject of much interest, and there is no shortage of cinemagoers to attend the N.G.T.E. film on jet noise—and to be quizzed on their own subjective reactions to different types of noise.

Thursday's news announcements include the achievement of a 2,500 hr overhaul life for the Rolls-Royce Dart 510s of K.L.M.'s Viscount fleet; and discussions between Fiat and Microcell concerning the possible use of Microcell glass-fibre rocket launchers for the Fiat G.91 NATO fighter.

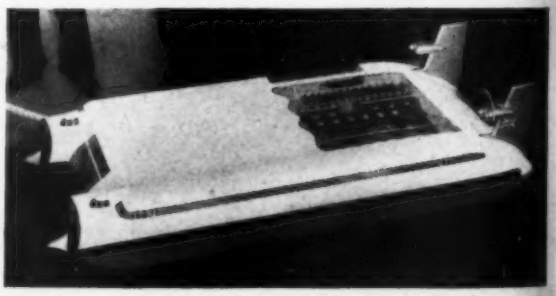
The Public Days

Friday, September 11 From the cockpit of a Twin Pioneer at about 350ft above the airfield, Farnborough was a 55-second blur of people and aeroplanes and runway and tentage. Ahead of and just below, so that we were almost fanned in the hot afternoon sunshine by their whirling rotor-blades, were a Sycamore and a Whirlwind; close alongside, like chicks with a mother hen, were two Pioneers; and as the Twin Pioneer pulled up over the helicopters at the south-eastern boundary a Beverley appeared over the top of us, then a Hastings above it, then a Britannia, then a Comet: an airborne epitome of the present strength and flexibility of R.A.F. Transport Command.

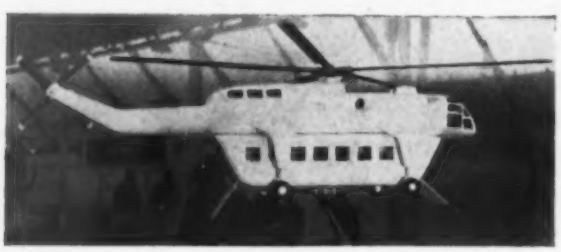
For those aboard XM960, a Twin Pioneer of No. 21 Sqn., the day's show had begun when we positioned before lunch "in the wings" at the famous old airfield of Upavon. The Pioneers of No. 230 Sqn. which were also to fly over Farnborough are based there, and another Twin Pioneer—as reserve—had come from No. 21 Squadron's headquarters at Benson. Take-off was timed for 1445; the flight was due to take 24 min 34 sec with a distance of 38.1 miles from the first check point to the far side of the airfield.

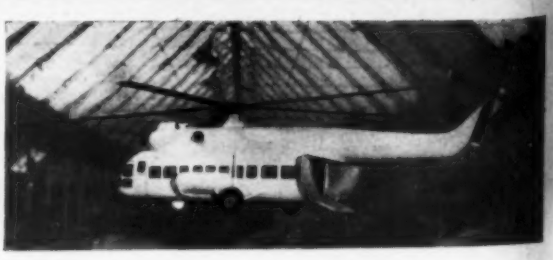
At starting-up time, when F/L. Graham Reith pulled the toggle which fires the starboard cartridge, nothing happened; the chain had stuck, as it did at Benson in the morning. The offending cartridge barrel was quickly changed, but the delay cost valuable time; so that when we came to turn on to our course of 103 deg the navigator, F/L. Bob Norton-Craig, counted us 40 seconds late. But being late (they had said, on experience earlier in the week) is better than being early on such a tightly-timed operation: it is easier to make up time than to have to lose it. Our flight plan airspeed was to have been 93 kt (ground speed also 93 kt, in hazy conditions with almost no wind); but "better make it 95-97 kt," the navigator advised. At the first check point, U.1, we were 45 sec late; scarcely anything had been gained or lost. F/L. Reith put up the r.p.m. to 2,400 and the A.S.I. gradually rose to 100 kt. The two Pioneers were comfortably settled in loose box formation; the reserve Twin Pioneer was still with us, as was another Pioneer, doing some photography. At U.2 (a road in a wood) the Twin

(Continued on p. 248, after page of helicopter pictures)



A far cry from their dainty helicopters, Saunders-Roe showed (right) a model of a 400-ton Hovercraft. Below, also in model form, are possible developments of the Westland Westminster. The pod (below) carries passengers and stretchers; the other version is a military rear-loader

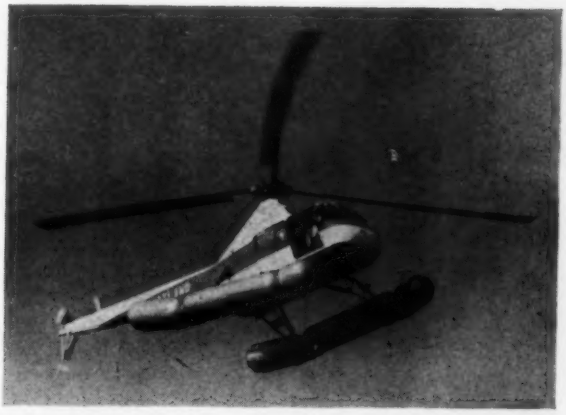




Farnborough Week . . .

HETEROGENEOUS HELICOPTERS

On the right, the Saunders-Roe P.531 and Skeeter are closing in to join their Westland cousins—from the left, the Westminster, Wessex, Gnome-Whirlwind, Leonides Major-Whirlwind, and Widgeon. Immediately below the Fairey Rotodyne is seen making a fast pass; and on the Rotodyne's right is a view of the Widgeon which shows the three separate pontoons on each side and the new, strengthened, skids. Finally, there are comparative views of the two Westminsters, the earlier machine being on the left



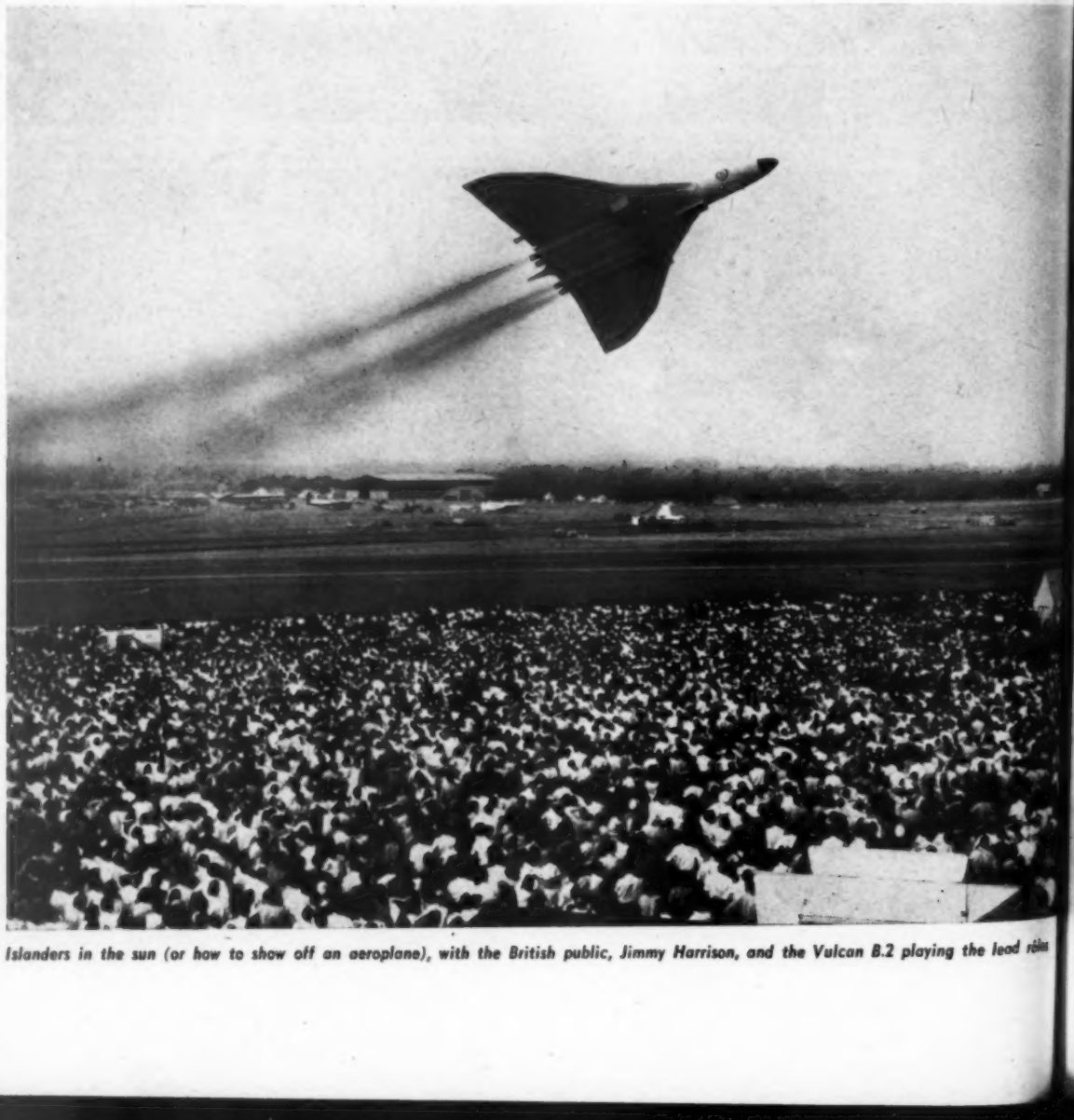
Farnborough Week . . .

broke away, to return to Benson: we were then only 25 seconds late, so gaining on schedule. At this point we heard the Hastings calling Farnborough and the Sycamore and Whirlwind report: "Helicopters at gate; five seconds late." (The "gate," for the Transport Command aircraft coming in to the display, was a railway junction just south-west of Basingstoke.) We ourselves just then came up to U.3, an embankment, only 15 sec late; and F/L. Graham remarked: "I can't see our yellow cornfield yet; I hope the farmer hasn't mowed it. (After a week's practice, and four days' Farnborough participation, the 21 Sqn. crew were beginning to know this route by heart.) F/L. Graham put the boost up to +1; the reserve Pioneer broke away; and our navigator said: "You've got half a minute to go; you can start trimming back a bit." The yellow cornfield came in sight: it had indeed been mowed; and we came to "the gate"—as F/L. Norton-Craig put it—"right on the button." His pilot said: "I'll keep it just below 90"; then we heard the Britannia calling up control. We held our height till just over some pylons, before descending for the run across the airfield; then, with two minutes to go, saw the final bomb-burst of Treble-One's display, with black Hunters pulling out to all points of the compass. In a minute we were in the show ourselves, with the helicopters ahead and quick glimpses of the Rotodyne and Hovercraft and other aircraft and some of the 22,000 people below, and in less than a minute out of it: pulling up over the helicopters and heading out on the "escape route" round by Milford and Haslemere. At Whitchurch we sent the two Pioneers home to Upavon and a little later turned on to course for Benson at a comfortable 3,000ft. At last, Reith and Norton-Craig could relax a bit; for No. 21 Sqn. another Farnborough day was over.

Saturday, September 12 On the second of the public days some 95,000 people saw what not even privileged guests of the S.B.A.C. had been able to see previously, the first public flight of the SC.1 and its change from vertical take-off to forward flight in the hands of Tom Brooke-Smith, Short Brothers and Harland's chief test pilot. This event, together with the daily just-airborne manœuvrings of the SR-N1 Hovercraft, gave this year's Show a special significance: for in these machines the British aircraft industry has successfully demonstrated its ability to master new dimensions. The news which came from Moscow on this day, that the Russians had sent a rocket boring towards the moon, was one in the eye for the Americans rather than for us; but if the firing was a purely astronautical act and not partly a well-timed political gesture, the British industry can at least claim to be doing things equally interesting, if less spectacular.

On the whole, however, this Saturday of the 1959 S.B.A.C. Show followed much the pattern of previous occasions except that it had a delightful soundless prelude—in the form of skilful Eagle, Skylark and Olympia glider aerobatics—and the weather was more stable and certainly warmer than for many previous years. Heat brings its own hazard, however, in the form of haze, which in this case persisted throughout the display. Another hazard was the fact that most aircraft had to land downwind, and in consequence one wheel of the NA.39 caught fire as a result of over-braking.

However much the flying may thrill the layman inside the spectator's enclosure, seen from the pilots' tent and off-stage where the participating aircraft are parked it appears rather more a matter of nonchalant routine. The pilots, those hard-working men for whom Farnborough provides a well-won public accolade, sit around comfortably in front of the refreshment tent with their wives and families. Occasionally they give a quick glance at



Islanders in the sun (or how to show off an aeroplane), with the British public, Jimmy Harrison, and the Vulcan B.2 playing the lead rôle

their watches to check the time they ought to be on-stage, and quiet informal briefings occur between pilots performing together or in adjoining items; then by ones and twos they move out to their aircraft. The Comet 4B and Vanguard fly hugely and gracefully round the circuit; the Javelin 8 exuberantly executes an eight-point roll and extends its undercarriage while inverted; the two Gnats and two Lightnings and two Hunters execute their one-seater, two-seater *pas de deux* round the Hampshire skies; the Rotodyne goes chugging across in horizontal flight; then by ones and twos the pilots return to resume conversations with families and friends and appraise professionally the other performers.

The ground crews tending the aircraft get first-hand performance reports from pilots on their return, just as if the flights were normal test routine. Occasionally unanticipated incidents occur: for example, a small fire in one of the smoke canisters of an R.A.F. Jet Provost (rather appropriately, shortly after the public parade down the runway of the airfield's emergency services). But on the whole Saturday's flying went off with the usual splendid precision, in the most summerlike September conditions.

Sunday, September 13 About 130,000 people attended on the final public day, so the SR-N1 Hovercraft had its biggest audience so far, and made the most of its opportunity. There was a fair breeze blowing from the north-east, and the Hovercraft made its way slowly into wind up to the end of the runway, where the 20 Marine Commandos who had been doing a daily stint as passengers leapt smartly aboard: they then had what might be called a fast run downwind and spectators behind the barrier got a good view of this remarkable machine, showing how "release from the wheel"—as its inventor, Mr. C. S. Cockerell, put it in his article on the Hovercraft in last week's *Flight*—has become a practical fact. The SR-N1 was also fortunate on Sunday in having, so to speak, the VTOL stage to itself; for the SC.1 did not perform on that day. Apart from the SR-N1 and SC.1, the public saw three new types—the Vanguard, Argosy and Dart Herald, the last-named making a welcome appearance after last year's accident to its fellow-prototype.

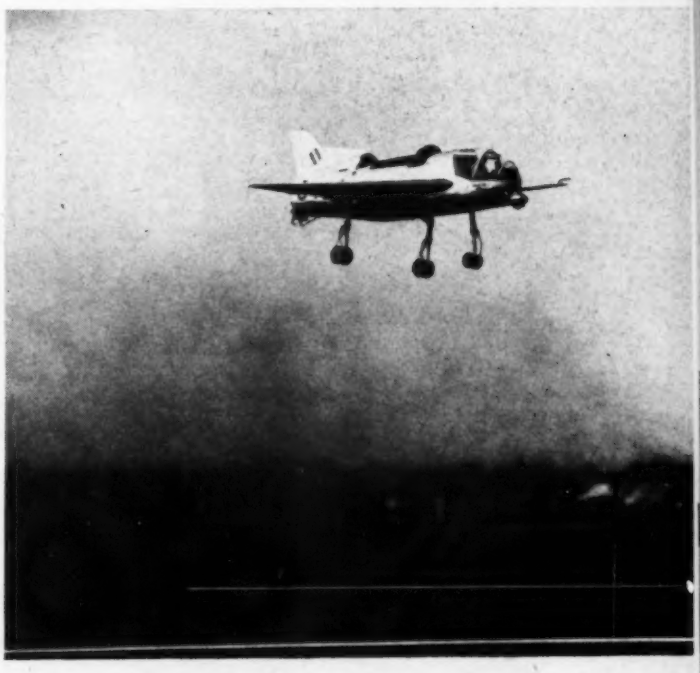
For the first time this week there was some cloud in the sky; and Bill Bedford in the Hunter Trainer momentarily disappeared behind it when he zoomed to 15,000ft for his smoke-trailing spin —doing thirteen turns to coincide with the 13th of the month.

A word of praise would not be out of place here for the way the Hawker pilots, Bedford and Merewether, and the other "double acts"—Beamont and Squier in the Lightnings, Tennant and Oliver in the Gnats—co-ordinated their displays, making good use of the limited time available to entertain the public and show off the varied capabilities of their aircraft. Acclaim, too, for the Westland - Saunders-Roe school of pilots: the recent combining of these firms enabled them to put up eight aircraft together, with two Westminsters at one end of the size scale, and the P.531 and Skeeter looking rather like the youngest in a family. In fact, the helicopter goings-on resembled an animated Giles cartoon, with something happening in every corner; but rounded-off with dignity by a line-up in front of the president's tent.

Upper left, Bill Bedford (Hunter Two-Seater Mk 66A) hauls off for a smoke before his spin. Immediately above, the Dart Herald is being (and the Vanguard is looking) very dashing in the new B.E.A. colours

In the president's enclosure: Earl Mountbatten, Chief of the Defence Staff, and Sir Dermot Boyle, Chief of the Air Staff

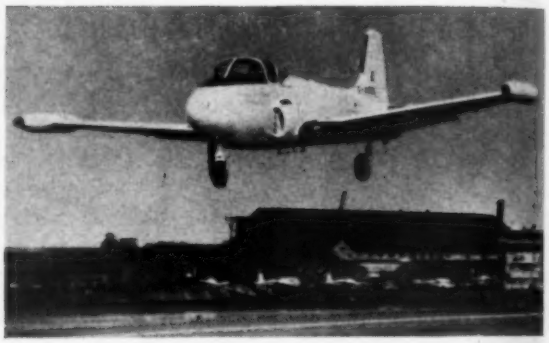
The Short SC.1 jet-lifts itself—together with some of the local terrain

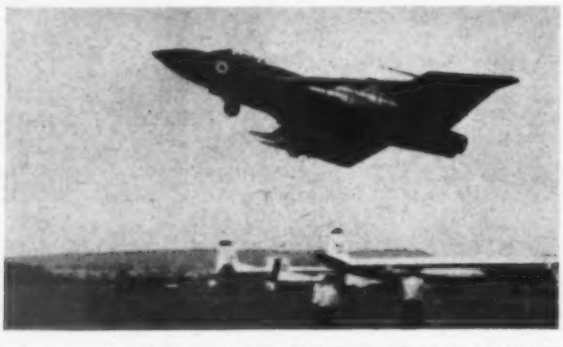


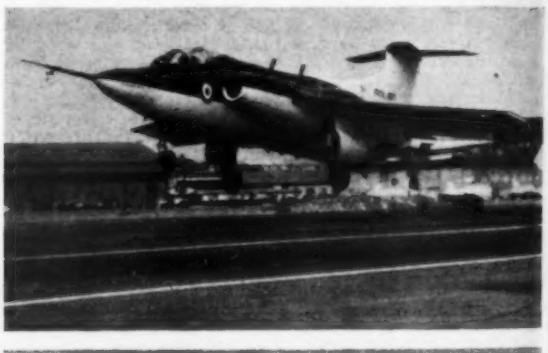
Farnborough Week...

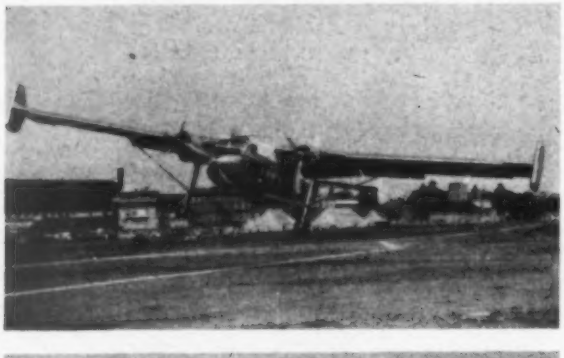
COMINGS AND GOINGS

Take-off and landing studies secured during the week: Left, three Scimitars of 807 Squadron approaching over two of their team-mates. In pairs, reading down, the two Jet Provost T.1s of the C.F.S. and the Viper 11-powered Jet Provost demonstrator; the Javelin FAW.8, Firestreak-armed, and the Blackburn NA.39; the Twin Pioneer, equipped for geophysical survey, and the Argosy; and the Gnat Trainer and Hunter 66A—making a particularly interesting comparison









Round the Stands

ILLUSTRATED MAINLY WITH "FLIGHT" PHOTOGRAPHS AND SKETCHES

WEAPONS

ALTHOUGH conspicuously absent from Farnborough, the **Avro Blue Steel** air-to-surface missile is no longer quite so tightly enwrapped in security. Immediately before the Show opened it was announced that the powerplant was the D.H. Double Spectre rocket engine. It can now also be stated that the missile employs an autopilot and inertial navigation system in order to find its way to its target without any outside help. An exhibit by Elliott Bros., commented upon last week (p. 211), strongly suggested that Elliotts are involved in Blue Steel inertial guidance.

Avro have also been permitted to state the following: when released from its parent aircraft (Vulcan B.2 or Victor B.2) Blue Steel initially falls free, both barrels of the Double Spectre being fired after a few seconds' delay; the missile accelerates, flying initially below its release height and then climbing steeply (the parent aircraft is flying on a reciprocal course by the time the missile is established in its climb). Blue Steel's airframe follows conventional aeroplane practice, except for "special precautions to combat aerodynamic heating." A canard, the missile manœuvres by twist-and-steer; and, following Valiant-launched model tests in Australia and Britain, full-scale test vehicles have been completed and flown.

In last week's issue (p. 211) brief details appeared of the quadruple shipboard launcher developed for the **Short Seacat**, together with a photograph of a full-scale model. The launcher is being produced by Rose Bros. (Gainsborough) Ltd., who have wide experience with similar equipment. It is fabricated in steel, and is slewed and elevated by an electric or electro-hydraulic system with totally enclosed geared drives lubricated by oil bath with drip feed to the gears and splash to the bearings. The control system may be linked to any suitable director sight via a data system, the inputs to the launcher being grouped at uniter blocks, with final distribution via flexible looms.

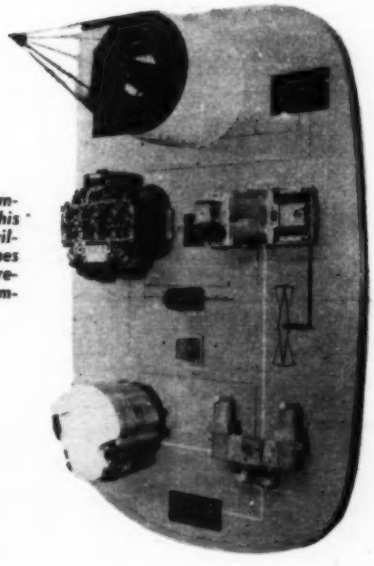
Loading of the launcher would be carried out at 90 deg. elevation, which brings the platforms beneath the base of each missile into a horizontal position. Rounds are brought up vertically and slid into engagement with the rails on each platform; the loaded launcher is then elevated for firing. To load the pair of rounds on the other side of the launcher the latter is slewed through 180 deg and the procedure repeated. Training and elevation stops can be provided, and these would be cut out of circuit during the loading sequence.

Altogether the launcher is neat and appears well suited to shipboard use. The weight of Seacat has not been divulged, but it would appear to be marginally possible to serve the launcher by hand. The related Tigercat land-based missile can be fired from a generally similar quadruple launcher carried by an armoured tracked vehicle (illustration overleaf). Again manual loading of the launcher appears possible. As we commented last week the vehicle appears to carry a guidance aerial, protected by a dished radome. Obviously these Short weapons cannot be wire-guided, and some form of command system is the likely alternative.

For the first time, **de Havilland Propellers** were allowed to exhibit essential elements of the guidance and control system of Firestreak. As is well known, this missile is an infra-red homer, and incoming heat radiation from the target is picked up by a reflecting telescope system gyro-stabilized on gimbals behind the glass nose of the missile. When radiation from the target is detected, the seeker system locks on to it and thereafter continuously tracks the target. The function of the seeker head is to determine the rate of change of the target sight-line and, according to a proportional navigation law, pass a demand signal for a certain acceleration in each plane per degree per second rate of change of target direction.

This signal is passed to the control-electronics unit—occupying some 4in of the forebody—which feeds a suitably processed signal to the pneumatic-actuator packages; these, mounted immediately further aft, position the control fins at the rear via push/pull rods carried inside the missile's axial fairings. The movement of the fins imparts acceleration to the missile, which is then measured in the control-electronics package and compared with the demand, the servo loop being stabilized by a very neat rate gyro. Firestreak's power supplies are largely of a pneumatic nature, served from a toroidal air bottle surrounding the motor tube, the pressure from which is reduced to 300 lb/sq in.

Of singular interest is the instrumented re-entry body from a **Black Knight** upper-atmosphere test vehicle which was on view on a Ministry of Supply stand. The specimen shown had been recovered after re-entering from a height of more than 500 miles at a speed of some 12,000ft/sec. The tip appeared originally to have had a radius of some 2in, an included angle of about 60 deg, and to have been of some form of ablative asbestos-reinforced plastic material; the remainder of the re-entry body appeared to have been fabricated from a single sheet of high-nickel alloy and, although truncated near the tip by impact, exhibited a high surface finish over most of its area, with blue and



Described in the accompanying narrative, this wall display by de Havilland Propellers outlines the functioning of Firestreak's infra-red homing guidance

Referred to briefly in last week's issue, this illustration depicts an armoured vehicle carrying four Short Tigercats in order to "carry anti-aircraft defence missiles well into forward areas"

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straw heat discolouration caused by the shockwaves from four bluff patches (of special material removed for examination).

Typifying their diverse work in the overall field of rocketry, **Bristol-Aerojet** have evolved a wire-wound liquid-propellant chamber in association with the R.P.E., Westcott. Primary combustion takes place in a parallel chamber, aft of which is a throat and divergent nozzle. Lined with a temperature-resistant plastic material—probably phenolic asbestos resin—the motor is regeneratively cooled by fuel entering at the nozzle end.

With several missile systems at the operational stage it is now apparent that such devices require extensive ground check-out equipment in order to effect rapid and automatic sequential test procedures immediately before firing. Particularly is this true of anti-aircraft weapons such as the **Armstrong Whitworth Seaslug,** and the shipboard system for this missile includes a completely automatic test equipment which checks fuzing, guidance, control, turbo-alternator and telemetry equipments simultaneously and independently, and finally initiates overall test of the entire weapon system. Included in the test equipment are supplies of electric power and high-pressure air to drive the airborne hydraulic pump and turbo-alternator. Typical of the many safety measures involved is the central operating panel into which connecting plugs have to be inserted before testing can begin; and from these plugs special keys have to be removed when the service connections are made to the missile.

Even a relatively simple system such as that of the Jindivik target is not complete without ground check-out equipment. Fairey Aviation displayed a test booth containing equipment for conducting the complete functional test on the assembled drone; facilities were provided for checking the control system, power-plant and the trials instrumentation (such as the miss-distance cameras).

The majority of large land-based missiles require ground air-conditioning before launching. In the outdoor equipment display **Sir George Godfrey & Partners** exhibited an air-conditioning set under the title "English Electric Scheme 3." The circuit comprises a Godfrey/SRM screw-type compressor delivering to a brake turbine c.a.u. via a heat exchanger for cooling by air induced by the c.a.u. compressor. A water extractor and pneumatic temperature-control valve were incorporated.

From the same manufacturer came the LEAP, or launcher electrical and air probe. This consists of a pivoted probe arm carrying at one end a 24-pin electric plug and incorporating an air valve which controls a link mechanism to determine downward and forward movement of the unit. When operated, the door of the LEAP's steel housing opens, the arm lowers and the plug is accurately inserted into its socket in the tail of the Seaslug. In order to feed electric power and conditioning air during the pre-launch cycle an ingenious feature enables the plug to engage accurately in the time of one second, notwithstanding the relatively large tolerances which must be allowed in the position of the socket with respect to the launcher. Disengagement takes 0.5 sec.

Among missile hardware on display by **G.E.C.** was a missile-attitude indicator system developed for the R.A.E. which measures the attitude of the Skylark research rocket about all three axes. The system involves a pair of powerful X-band transmitters stationed on the ground on either side of the range centre-line. Their transmission incident angles upon three flush aerials carried in the rocket, arranged forming two orthogonal interferometers, may be measured accurately with reference to each interferometer base-line to give the attitude of the vehicle to within a few minutes of arc.

Non-missile forms of armament are becoming relatively less significant, but a unique model exhibited by **M.L. Aviation** depicted a static rig used during the development of the most powerful devices of all. In order to detonate a nuclear device high over the Australian desert in 1957, this company, in collaboration with the M.o.S. and A.W.R.E., supplied a hoisting rig involving three balloons, locating the device within a radius of 100ft.

It would be foolish to deny that one can discern a trend in favour of the unguided spin-stabilized air-to-air rocket at the expense of gun armament. **Microcell** have achieved singular success during firing trials of 2in weapons—as a dramatic cine film testified—from such aircraft as the Canberra, Hunter, Javelin, Sea Vixen and Lightning. Also associated with 2in air-to-air rockets is a fin venturi unit, developed for the M.o.S. by M.L. Aviation, with four tangentially deployed fins which flick out as the missile leaves its tube and thereafter remain locked open by springs.

In view of the profusion of high-performance targets available, or under development abroad, it is remarkable that only one such device is an active project in the Commonwealth. Nevertheless, the **Jindivik,** produced entirely by the Australian Government Aircraft Factories in Melbourne, is an exceedingly competitive basic design which has already shown itself to be amenable to considerable stretching.

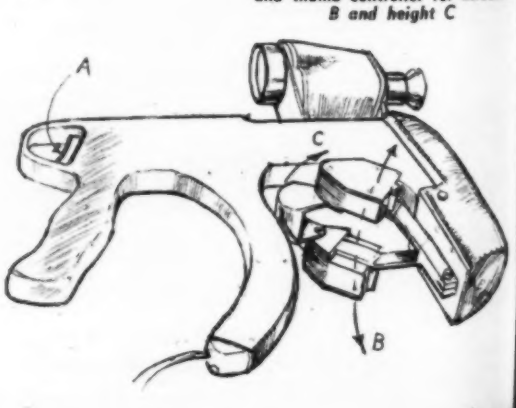
Initially powered by Armstrong Siddeley Adders and early Vipers, the current production version is the Mk 2B, powered by a Bristol Siddeley Viper 8 (1,750 lb rating). Information recently revealed includes the following data: launching weight, 3,000 lb; internal fuel, 95 gal; speed at operational ceiling of 55,000ft, 595 m.p.h.; endurance at 55,000ft, allowing for take-off and climb with 30 gal remaining for descent and landing, 66 min; and rate of climb at 40,000ft, 3,500ft/min.

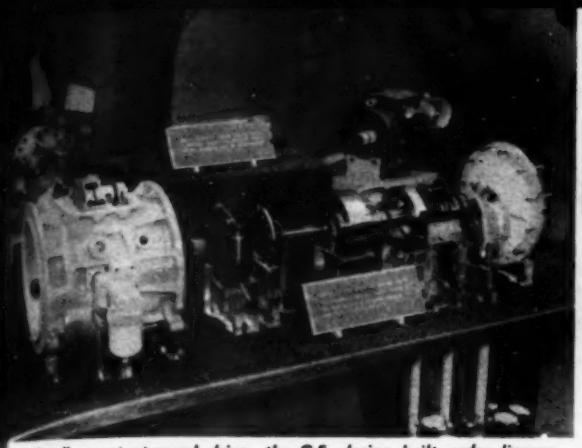
Production is also now in hand upon the Mk 3, powered by the 2,500 lb thrust ASV.11, giving 5,000ft greater altitude and a rate of climb of 5,800ft/min at 40,000ft. From May 1961 onwards the 2B and 3 will be replaced by the 2C and 3A, incorporating improved autopilot, telemetry equipment and power supplies in order to confer improved handling at high altitudes. Jindiviks have already been sold—through Fairey Aviation, the European agents—to the Royal Swedish Air Board, and other markets are in prospect. It is permissible to state that schemes for catapult launching and parachute recovery in naval applications are under development, and that work is also in hand upon a low-level tactical reconnaissance version equipped with TV and conventional cameras.

Each wing of the Jindivik 2B target (above) carries a pod housing only two miss-distance cameras, but these have lenses covering a very wide field of view

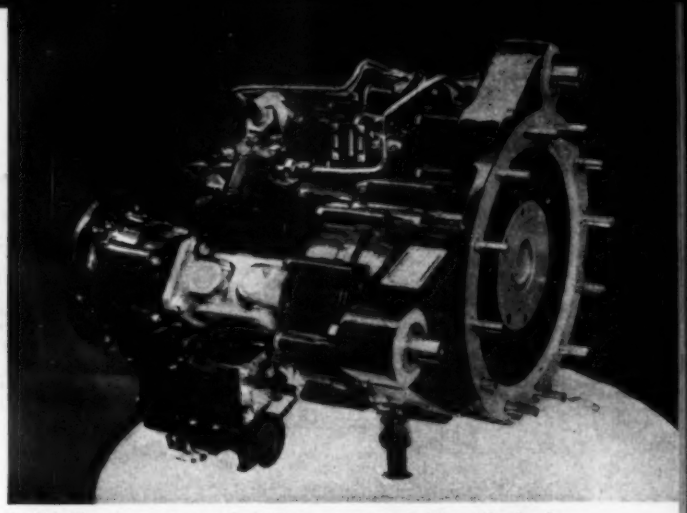
In the accompanying text it is suggested that 2in air-to-air rockets are tending to displace gun armament. The sketch (left) depicts the latch and electrical firing contact at the rear end of a Sea Vixen's 24-tube Microcell rocket pack

(Below) The control unit for the Vickers Vigilant comprises a monocular sight, firing trigger A, and thumb controller for direction B and height C





Rotol's constant-speed drive—the G.E. design built under licence—is particularly competitive on the score of weight



English Electric are to supply both constant-speed drives (the Sundstrand design) and A.C. generators for the VC.10. This is one of the first British-made drives, of which a number are now running

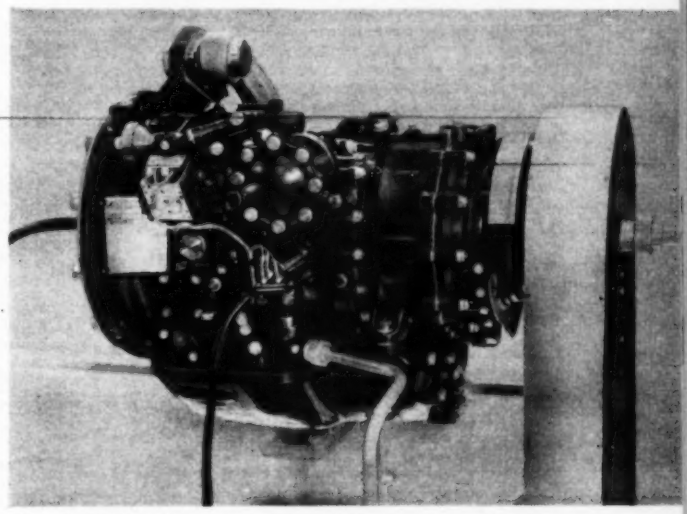
ACCESSORY POWER

SINCE electrical power has such an important function in the modern aeroplane, it was not surprising that a year or two ago a major technical battle should have developed within the industry for the supply of equipment for the A.C. electrical systems that were at that time proposed. Many firms entered the field with A.C. generators or the constant-speed drives that were needed to rotate them.

At least as far as the two major British civil transports are concerned, the battle now seems to have been resolved: **English Electric** are to supply at least a number of Sundstrand drives and A.C. generators for the VC.10 and **H. M. Hobson** and **British Thomson-Houston** respectively the constant-speed drives and alternators for the D.H.121. This is not to say that competition for the supply of units for these aeroplanes has now ceased. In the case of the VC.10 the number of drives ordered is limited—possibly so that a competitors' unit could later be specified if it looked promising—and orders for D.H.121 constant-speed drives have not yet been placed, although it is understood that the Hobson unit will be fitted to the RB.163 engines for this aeroplane. Undoubtedly there is more actual operating experience behind the English Electric Sundstrand drive than with any British-designed equipment, and when English Electric say that their drives (which they are required to make to a comparable standard to that of U.S.-built Sundstrand units) will have an initial overhaul period of 800 hr with quick development to 1,200 hr they can use actual American operating experience as a guide. In a few years time, they say, overhaul periods of 2,000 hr should be achieved. A small number of English Electric units have now been completed and some early experience should be obtained when the Boeing 707 goes into B.O.A.C. service, as English Electric have a spares contract with the Corporation for 707 drives.

In conjunction with their constant-speed drive, English Electric have developed a 40 kVA A.C. brushless generator, designed to be driven at a constant speed of 6,000 r.p.m. This unit is still quite new, but 3,000 hr running experience had been obtained by the start of the Show. This unit has a five minute overspeed rating of 11,000 r.p.m., an overload rating of 60 kVA for five minutes and 80 kVA for five seconds. It weighs 86 lb.

Both Hobson and B.T-H. have been affected by the recent changes in the size of the D.H.121. Originally 30 kVA were required from the alternator and drive when this was matched to the RB.141 engine. For the RB.163 the requirement is less, and both firms are producing new units which, in combination, will give a 22½ kVA supply. What this must mean in terms of delay in supply of equipment to the aircraft is not easy to assess, but Hobson estimate that their development will be delayed by about six months and B.T-H. say that they hope to have the new 22½ kVA unit running in February or March next year. It is quite clear that in both cases a considerable amount of work is required in the scaling-down process. Design of the 40 kVA B.T-H. self-exciting brushless alternator, for instance, took three months and manufacture twice this time. Nevertheless, the development staff of both firms are naturally not dissatisfied that they can have second thoughts on these units so soon after completion of the first design, and there is every reason to suppose that better units should result. One major advantage in prospect is that for a drop in alternator output of 25 per cent, there will be a weight reduction of 30 per cent in the constant speed drive (from 94 lb to 66 lb with cooler) and 41 per cent in the alternator (from 85 to 55 lb). Hobson have put a great deal of work into constant-speed drive development at Wolverhampton. Five experimental drives have now been completed; delivered units should have a pre-



This 30/40 kVA Hobson constant-speed drive is to be produced in 22½ kVA form for the Airco D.H.121

liminary overhaul period of 1,000 hr with a rapid build-up to 2,000 hr.

Although the particular requirement for the D.H.121 has changed, applications for 30 or 40 kVA alternator power still remain. Hobson and B.T-H. are hoping to find purchasers for their larger units in Vickers and English Electric for the TSR.2.

Other companies in the British constant-speed drive field are **Rotol** (who manufacture the General Electric unit under licence), **Lucas (G.T.E.)** and **Plessey**. The first-named now has an American-built 40 kVA G.E. drive running at Gloucester and driving a B.T-H. alternator. The G.E. range includes 9, 20, 30 and 40 kVA drives and one of these could well be first reserve for the D.H.121. The company also have hopes of being the supplier for the TSR.2, either with a G.E. drive or possibly a turbo-alternator unit such as the Rotol unit fitted to the NA.39.

As another supplier in the 30 kVA constant-speed drive range, Lucas displayed their hydraulic drive which weighs 70 lb. This unit has a normal output of 30.2 h.p. which may be temporarily increased to 80.2 h.p. A subsidiary company of Lucas, **Rotax Ltd.**, produce a range of brushless alternators and a self-contained 50 kVA bleed air turbo alternator, a high-speed machine which runs at 24,000 r.p.m. Rotor and turbine wheel are mounted on a common shaft running at the governed speed and the unit is suitable for parallel operation of other similar alternators by adding a small power-equalizing unit and a protection unit fitted with a synchronizing device. Another development of this company is an environmental-free solid-rotor brushless alternator. There are a number of types in production at the moment delivering outputs up to 20 kVA, but further design and development work should result in machines giving outputs of up to 60 kVA at 8,000 r.p.m. The 20 kVA model weighs 47 lb.

Ram air turbines were again much in evidence at the Show,

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most of these now being production units. They included designs by Rotol and by Plessey, whose 15 kW TRA 170/27 is now being produced in quantity. **Dowty** were showing their Transmatic drive hydrostatic transmissions—not a new development, but displayed for the first time driving an aircraft undercarriage wheel.

Finally, an important and interesting new unit appeared on the English Electric stand. This was a brushless 9 kW direct-current generator producing 300A 30V supply at 5,000 to 8,000 r.p.m. and operating at up to 65,000ft. The exciter of this unit produces a three-phase alternating voltage which is fed by silicon rectifiers mounted in the rotor shaft to the generator field windings. The alternating voltage produced by the static output windings of the generator is rectified by silicon rectifiers mounted in the frame.

PERSONAL EQUIPMENT

THE general trend in the personal equipment exhibited this year was one of steady improvement rather than startling innovation. On the military side both **Martin-Baker** and **Folland** automatic ejection seats were on view, the former used in almost every military aircraft from basic trainer to supersonic fighter and the latter installed in its latest version in the Folland Gnat Trainer. Martin-Baker production is now concentrated on the many versions of the Mk 4 lightweight seat, to which the latest "star" modifications are being added. Mk 5 versions are also being produced in quantity for the U.S. Navy and are being retrospectively fitted to many NATO aircraft of American manufacture and to the F-104G. Mk 5 versions are also destined for the NA.39 and the Hawker P.1127. The company is confident that Mk 4 and 5 seats will provide adequate protection up to the highest indicated airspeed likely to be encountered. Ground-level and high-speed devices are standard and several seats now have the patent Personal Equipment Connector and an electric seat-height adjustment motor. Over 95 per cent of emergency ejections are now proving successful and more than 300 lives have been saved. Incidentally, a VTO version of the Martin-Baker seat is fitted in the Short SC.1 and the Dornier Do29. The particular seat exhibited in the show was a Mk 4BS for the Lightning.

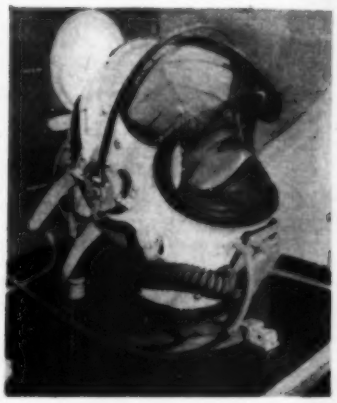
The **Frankenstein** pressure jerkin and g-suit combination for partial pressure protection is still the R.A.F. standard together with **Baxter, Woodhouse and Taylor** partial pressure helmet. Modifications to the latter include improved sound exclusion and oxygen mask fit. Although not yet in general service the helmet is approved for squadron use and more than 200 have been made. **M.L. Aviation** exhibited the latest version of their partial pressure helmet with larger visor, flexible self-fitting oxygen mask, visor closure actuated by absolute pressure rather than pressure drop and an internal sun visor. For more usual wear, **British Oxygen Aviation Services** exhibited the new R.A.F. Q-type mask which rests on the chin and is retained by a two-stage toggle frame acting on a plastic skeleton providing a close fit for pressure breathing and protection against air-blast. Also shown was a 3½ litre stainless-steel liquid oxygen container and automatic pressure-demand regulator equivalent in capacity to 2,600 litres of gaseous oxygen. The container is entering Fleet Air Arm service where it is used with a standard regulator.

Considerable strides are being made in improving dinghies and life vests. **R.F.D.** showed, for dinghy aprons, the new nylon closure, of Swiss origin, based on tiny nylon hooks and loops on fabric strips which instantly engage to form a continuous closure, but can easily be broken apart. For civil use the company is producing dual-chamber life vests, conforming to American requirements, but designed so that a single chamber will fully support an unconscious person. A brand new device is the Injectair inflation system in which compressed air is blown into a venturi to entrain atmospheric air to assist in dinghy inflation.

Frankenstein exhibited the new Beaufort 26-seat reversible life raft permitting all-round entry and having a canopy centrally stowed so that it could be extracted from either side of the floor and would automatically position itself on inflation. This greatly simplifies erection of the shelter in bad weather.

A jet air-inflation system engineered by **Walter Kidde** and **Normalair** was shown. The former company had also engineered an automatic inflation initiator using synthetic sponges which swell in water and release the firing pin. This is the first operationally acceptable device of this type. Latest Walter Kidde development is a one-man dinghy which is automatically released from a seat-type pack on immersion, positioned beneath the wearer by a high pressure tube and then inflated to support the man automatically even if he enters the water unconscious.

Ultra exhibited the first automatic distress beacon in the world designed for life rafts and **Burndept** showed the navy's V.H.F. TALBE personal beacon, now also used for mountain rescue in Switzerland, and the SARBE U.H.F. beacons in Fleet Air Arm and, in future, in R.A.F. service. SARBE is produced for wear on pressure clothing or with voice facility and transmits on 243 Mc/s.



(Left) Martin-Baker Mk 4BS automatic ejection seat for Lightning. It has ground-level and high-speed devices, leg-restraint garters, personal equipment connector and electric seat - height adjustment

(Right) Baxter, Woodhouse and Taylor partial-pressure helmet. More than 200 have been produced

MATERIALS AND METHODS

A PERIOD of consolidation of past developments appears to be taking place with metallic materials. While there has this year been no startling event comparable to the introduction of titanium as an engineering material, there have been remarkable advances in the techniques of melting, casting and fabrication of existing proved alloys.

Especially noticeable is the emphasis on the use of vacuum melting and casting. Thus **William Jessop & Sons** show an exceptionally large titanium ingot, made of course by this method, but they have also extended vacuum melting to steel and alloy ingots, with a resultant freedom from porosity and a metallurgical soundness unattainable in the past. This process of vacuum casting has also been utilized by **D. Napier & Son** for the production of precision castings in a variety of materials, including Nimonic alloys.

As an illustration of the advantages of vacuum casting, the properties of Nimocast 713C, a nickel-chromium casting alloy made by **Henry Wiggin & Co.**, are of interest. A comparison of the stress-to-rupture properties of vacuum-cast, and cast-in-

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argon metal shows a marked superiority in the vacuum-cast alloy. Incidentally, Nimocast 713C is a new investment casting alloy for high temperature service, and forms a possible alternative to wrought alloys for gas turbine rotor blades.

Henry Wiggin over the eighteen years since the first Nimonic alloys were introduced, have produced so many notable advances in the heat-resisting alloys that there is a danger that their latest product, Nimonic 105, might fail to draw the attention it deserves. It is difficult to convey by a few figures the properties of a material, when the three variables of life-to-rupture, temperature, and stress are involved, but Nimonic 105 when stressed at 7 tons per sq in at 940 deg C has a life-to-rupture of 50 hr, as well as considerable resistance to corrosion at this temperature.

Under the influence of missile development, and high speed aircraft where the "heat-barrier" poses its own peculiar problems, heat-resisting and stain' .ss steels featured strongly with many exhibitors.

Firth-Vickers Stainless Steels were showing a new steel, FV520, which has potential uses for the skinning of high speed aircraft and missiles, since it combines heat resistance with lightness, while **Firth-Derihon Stampings** featured nickel-based alloys for gas turbine discs in addition to the more usual ferritic alloy steels.

In the more moderate temperature range of 400 deg C—500 deg C, Titanium 679, developed by **I.C.I. Metals Division,** shows superior resistance to creep, while another new alloy, Titanium 230, combines the easier working of softer material with the strength of titanium alloy.

Turning now to methods of shaping metals and alloys, the castings shown by many exhibitors had a finish and dimensional accuracy that was really surprising. Noteworthy was a casting made by **Sterling Metals** in a magnesium-base alloy which showed a thin section and a degree of finish that would not have been seen a year ago, and which may therefore be classed as a new development. "Centrispinnings" shown by Firth-Vickers Stainless Steels revealed a freedom from defects which made them indistinguishable from wrought metal.

Mere size may mean nothing or be very significant, but in the case of aluminium alloy plate it is significant to both the aircraft engineer and to the plate manufacturer; **Northern Aluminium** can now offer plate up to 50ft long and 7ft wide, though since length, width and thickness, as well as the size of ingot, are interrelated, these extraordinary dimensions may not all be realised simultaneously. Since the plate is stress-relieved by a process involving stretching, this means a plate stretcher capable of dealing with a cross-sectional area of plate of 200 sq in!

Another shaping problem has been solved by **Reynolds T.I. Aluminium.** In a striking exhibit they show stepped tube of aluminium alloy; not only may the outside diameter be raised in one and the same tube, but the wall thickness may be varied also. This makes possible the threading of thickened ends, without wasteful machining of the rest of the tube.

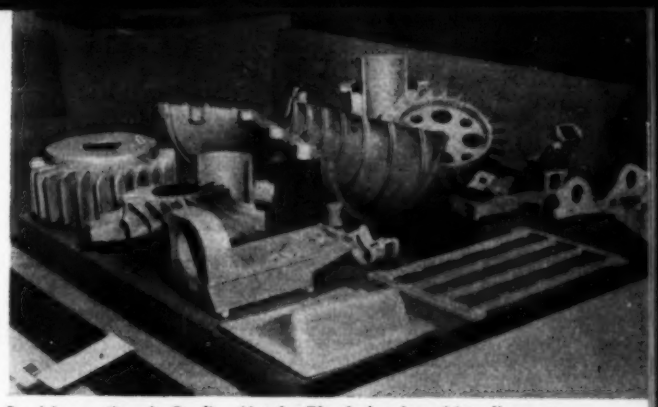
What is flow turning? It is a combination of spinning and extrusion whereby a circular metal blank is fabricated into a spun shape, but in which the wall thickness may be varied from the original blank thickness down to very thin sections. This was shown by **Wilmot Breeden** on cones and venturis, but would appear to have many other applications.

Plastics, synthetic rubbers, and resins generally, tend to bewilder by the sheer number of types available, by their difficult chemical names, and by virtue of the fact that they may appear superficially to be indistinguishable one from the other. It is a help then to have a short and distinctive trade name, and one of which a great deal more will be heard is "Viton," a fluoro-carbon synthetic rubber for high temperature service (approx. 250 deg C max.). Viton has also a resistance to a wide range of fluids. It is manufactured by the **Avon India Rubber Co.** and is offered as component parts by **George Spencer Moulton** and also by **Ronald Trist,** who are specialists in many varieties of high-performance rubbers.

"Propathene," which as its name suggests is a member of the polythene family, is resistant to temperatures up to 150 deg C, while showing the same chemical inertness as polythene. This and a new material "Kralastic" are made by **I.C.I. Plastics Division.**

In a class of its own is a new material "Astrasil" which comprises woven silica cloth laminates bonded with a resin. This is resistant to the really high temperature of the oxy-acetylene flame, the "burn-through" time being considerably greater than a similar thickness of a stainless steel or of glass-cloth laminate, which it resembles in appearance only. **British Refrasil** market "Astrasil" which is of great interest to missile engineers, and others concerned with the "heat-barrier."

The problems of fastening structures together has evidently been intensively studied recently from the aspects of security, ingenuity of method, and weight-saving. Ingenious methods of locking and weight saving were shown by **C. J. Fox & Sons (Aviation),** who are the sole distributors in this country for the Kaynar Company of America. Weight is saved by the ruthless paring away of unnecessary nut material, strength being retained by the use of high tensile steel. The locking is affected by a slight elastic distortion of the nut. **Guest, Keen & Nettlefolds** achieve locking by the well-known method of a nylon insert in the nut, or in the bolt. Both systems have the advantage of being capable of re-use after dismantling.



Precision castings by Sterling Metals. The dark-coloured impeller, cast in magnesium, has an exceptionally high finish

Logically, it is but a step to save weight further by dispensing with separate fasteners altogether, where this is possible. This may be achieved by spot-welding or by flux-less vacuum brazing. **Sciaky Electric Welding Machines** showed a light sandwich construction in austenitic stainless steel, assembled with many thousands of tiny spot welds, whereas **Centrax** achieve a similar result by vacuum brazing with an 80 per cent nickel alloy, resulting in a flux-free assembly capable of a working temperature of 800 deg C. Centrax also had a tip-shroud ring for turbine blades which allows for blade creep, the tip of the blade burring over the open ends of a very thin honeycomb brazed to the inner face of the shroud ring, the effectiveness of the gas seal thus being retained.

Among the exhibits which defied classification under any hard and fast heading were a stainless steel, convoluted, fully flexible tube which could be bent by hand to follow the most tortuous path in engine bays and airframes. This was shown by **Accles & Pollock** and its advantages over rigid pipes would be evident to those responsible for mock-ups and trial installations.

An interesting new method of applying "marking-out ink" was shown by **Brent Chemical Products.** Ardrox 381 is an Aerosol consisting of a blue ink which is sprayed on and is removable by trichlorethelyne. A useful adjunct for non-destructive testing was a white strippable paint, also sprayed on, which may be applied to steel parts on which it is desired to use black magnetic crack detection "ink."

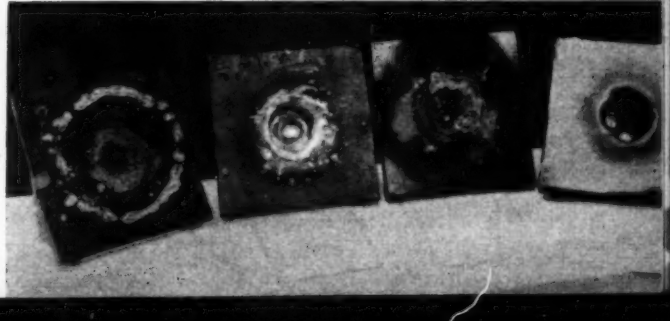
FLIGHT CONTROL

Powered Flying Controls The tremendous development that has gone into powered flying controls in recent years has now undoubtedly slackened. Of flying control hardware itself, little that was revolutionary was to be seen at Farnborough; in fact, each manufacturer has settled more-or-less firmly on one line of development and is offering that in any new system. **Boulton Paul** continue to show their rotary valve (applied to the NA.39 flying controls), **Dowty** use their licence-built Moog valve in a new 4,000 lb thrust aileron control with integrated autostabilization, **Fairey** have continued work on the sliding-plate valve and **Hobson** again offer controls with spool-type valves.

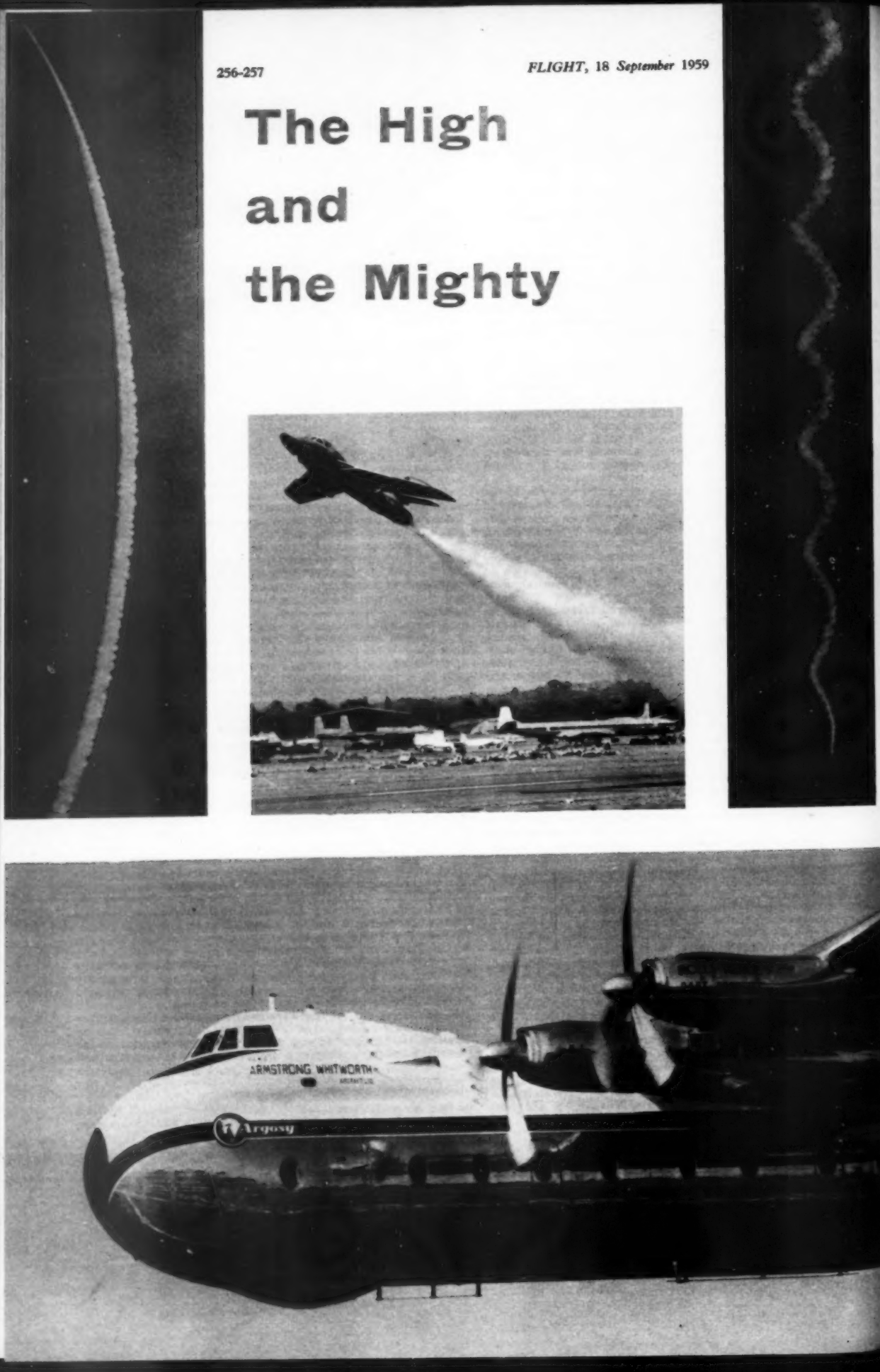
Where the interest lies is in the type of system into which the powered flying control unit—which must now be considered as the straightforward element in the system—is installed, and the manner in which provision is made for autostabilization, for the autopilot, and for a completely fail-safe system. During the first

(*Continued on p. 258, after double page of aircraft pictures*)

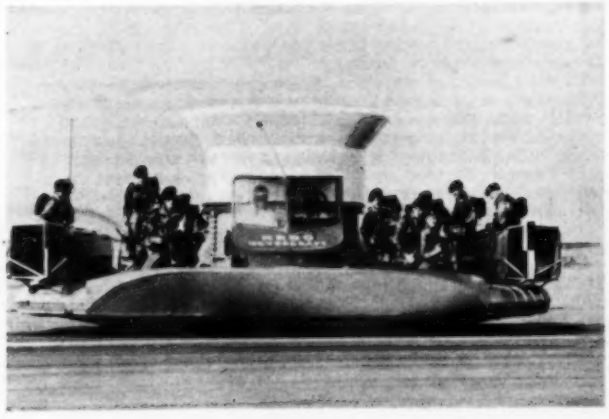
In tests under identical conditions, British Refrasil's Astrasil (extreme right) took three times longer to burn through than did stainless steel, and many times longer than the two other materials shown

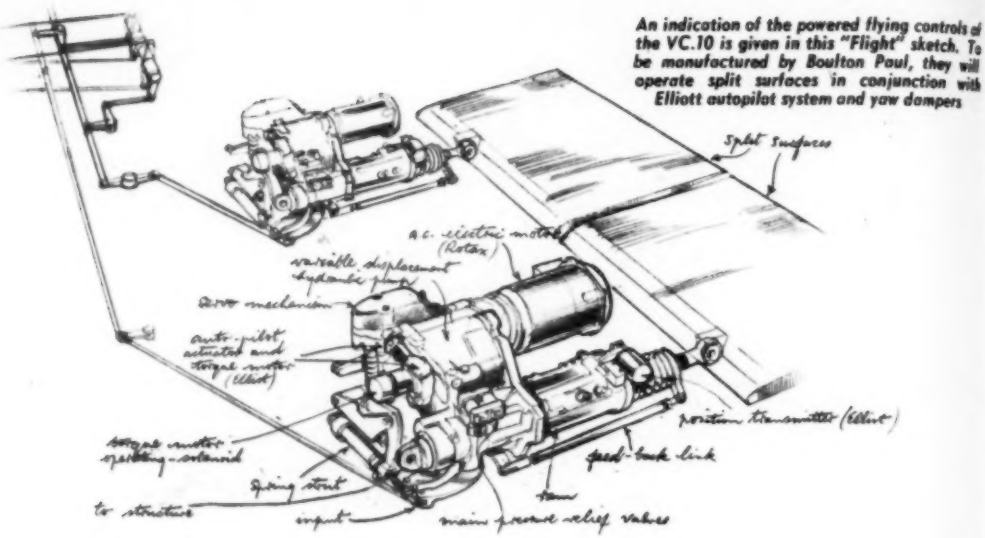


The High and the Mighty



....and the odd man out.
As the Hunter Two-seater unsticks Bill Bedford cuts in the smoke generator (centre opposite). He builds up M=.95 or so, pulls the Hunter up to eight or ten thousand feet—and spins, and spins, and spins (opposite, l. and r.). The Argosy (lower left) sails glinting by; and the mighty Lightning T.4 (above) gives a fair imitation of an inquisitive goldfish. Fortunately for the Hovercraft (right) the Royal Marines have not manned the fighting top





An indication of the powered flying controls of the VC.10 is given in this "Flight" sketch. To be manufactured by Boulton Paul, they will operate split surfaces in conjunction with Elliott autopilot system and yaw dampers

Round the Stands . .

days of the show, for example, it became clear from the information given out by Vickers, by Boulton Paul (who make the flying controls) and by Elliott (who are responsible for the integration of the autopilot, air data computer and possibly for autoflare and automatic landing aids for the VC.10) which arrangement is to be adopted in Vickers' new transport.

It is confirmed (and was recorded last week) that split control surfaces will be used on the VC.10, each driven by a single Boulton Paul flying control. These will be, broadly speaking, similar to those supplied by Boulton Paul for the Avro Vulcan with a variable displacement pump and a differential-area piston-type servo valve. They are self-contained and require only the supply of electrical power to energise the constant-speed motor driving the pump. As one of the failure cases which the system takes into account is a seizure of the unit, a collapsible spring link is incorporated between the input lever and valve so that—at the expense of a small additional force—the remaining divided surfaces can continue to function. There is also a duplicated mechanical linkage extending from the pilot's control up to the flying control input levers.

Elliott electromechanical autopilot actuators are integrated into the system in such a way that, where there are four split surfaces, only two autopilot actuators are required, and only one of these will function at any time. Each actuator is connected into the linkage in such a manner that it will operate all four split surfaces.

In the autopilot mode the power control position-feed-back linkage is locked and replaced with an equivalent electrical feed back—an arrangement which allows a large increase in autopilot authority and incidentally also results in surface movements being transmitted through to the pilot's control. In this way artificial feel forces (from the box at the base of the stick) are transmitted as a reaction force at the manual-feedback linkage locking point. This reaction increases with movement of the runs against the feel simulator and is spring limited to a predetermined value to provide autopilot torque limitation.

A special feature of the Elliott design is a comparison monitor comprising a set of sensors and computing elements operating in parallel with the associated "driving" autopilot—a system developed from the comparison arrangement incorporated in the Boeing 707's PB 20 autopilot. A logic arrangement assesses differences between the two autopilot systems and disengages the autopilot if certain tolerances are exceeded: it can discern the difference between malfunction and genuine autopilot demand.

Other new systems under development are intended for the Hawker P.1127 and for the Vickers-English Electric TSR.2. For the former, two competitive systems are being developed in parallel, one of which is being produced by Fairey. If the control that was last week shown on their stand could be taken as a guide (although it was not representative of a P.1127 unit) this may be the first British aircraft to be equipped with electrical signalling as the primary control system and with only a manual standby. Fairey's work during the past year has been concerned with development of a more completely integrated arrangement of electrical signalling with manual standby and autopilot (with an elaborate computing system) and autostabilizer demands superimposed on the signalling system. Triplication would be used to cover a control runaway, or duplication and special sensing devices to throw out the faulty system; failure of the electrical system would result in the manual system being latched-in in the usual way.

In the Fairey arrangement, the control servo loop is closed by surface position. This means that the auto-control system must operate from trim datum rather than surface neutral, and the normal trimming system would put a large error into the control loop if the signal were not backed off in some form. Various methods, Fairey say, are available for doing this.

On the Hobson stand was a pair of aileron power controls shown for the first time with a Newmark autopilot (evidently that of the Sea Vixen) with Mach and height hold facility. Hobson electro hydraulic autopilot actuators, the authority of which are limited by their stroke and linkage, supply effort according to autopilot signals. The actuator can apply a small angle quickly or the overall trim system a large angle slowly. In either case a runaway condition can be overcome by reaction at the stick before a dangerous condition is reached; the autopilot is then switched off manually. Hobson are also said to be examining the type of flying control best suited for the TSR.2; but some time must pass before any details of this can be revealed.

No powered flying controls were shown on either the **Smiths** or **Sperry** stands this year, although an integrated system to which both companies are contributing is believed to be still under development.

Take-off Monitors Design of a monitor that will continuously assess performance during take-off and give the pilot a genuine go/no go indication is no easy task. Thus a good deal of interest was evinced by the take-off monitor system shown on the **Honeywell Controls** stand. It measures aircraft acceleration and distance travelled and displays information about changes in aircraft thrust and drag and in distance remaining to refusal point.

Circuit interlocks prevent premature abort signals being given or abort signals occurring after the aircraft has passed the refusal point. The indication is given as a green "go" signal or a red "no go" and an optional display will provide an indication of actual against minimum acceptable acceleration. The system comprises an indicator panel which includes "distance to refusal point" and the go/no go signal; a control panel with pre-setting knobs for acceleration, gross weight and distance to refusal point; a computer; an accelerometer and an odometer mounted in the aircraft main axle assembly. An alternative odometer—which is more suitable for retrospective fitting—incorporates a wheel switch located on the mainwheel assembly and a pulse transducer located in the computer.

Autopilots While complete integration is virtually inevitable in any new airliner—and probably also in military aircraft—the state of the art as far as helicopters are concerned has not quite reached so advanced a stage. Nevertheless there is definite progress towards a fully integrated control system. **Louis Newmark** showed on their stand the helicopter autopilot being supplied for Whirlwinds, but also suitable for other helicopters. It provides stabilization from three rate gyros and attitude and heading control from panel-mounted instruments. Force sensers cause manual movement of the column to control the auto-pilot.

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An entirely new anti-submarine helicopter autopilot of a more advanced type was shown this year for the first time in conjunction with a licence-manufactured Lear three-axis attitude indicator. This has a globe on which the "equator" division between black and white halves represents the horizon and heading marks are applied like longitude lines, with a numbered scale of degrees at the equator. The globe is fully free in pitch and roll without gimballing error or discontinuity. A conventional miniature aircraft silhouette provides the fixed attitude reference and may be adjusted to compensate for long nose-up or down and roll attitudes. Later versions are also to have rate of turn and three-axis director information as required.

Produced under licence from Lear Inc., the globe horizon is incorporated in the new helicopter autopilot which is a series system—servo movement is not necessarily reproduced in the control column. The control panel indicates that height holding may be derived from a radio altimeter, a barometric capsule or, apparently, from a Sonar cable, thus allowing for automatic hovering during search for submarines. Also included in the autopilot is an MA.1 gyro magnetic compass system with adjustable latitude compensation and an attitude gyro. Separate trim controls are provided for varying c.g. positions and for yaw. Nothing was revealed about the particular application of this autopilot but it might be reasonably presumed to apply to the next Fleet Air Arm anti-submarine helicopter, the Wessex.

Instruments The **Kelvin Hughes** Flight Data System tape-instrument panel is now fitted in several new military types, in combination with the **S. G. Brown** master reference gyro, the Mk 5 compass system and Kelvin Hughes' own air data computer. In the Gnat trainer the roller blind instruments are supplied with heading and attitude signals from a Ferranti gyro vertical and a separate compass system, because of space limitations. S. G. Brown have this year shown for the first time their Mk 2 M.R.G. operating roller blind attitude indicator and a compass. Both Mk 1 and Mk 2 M.R.G.s can additionally supply heading and attitude signals to autopilot and radar aerial. The Mk 2 weighs 20 lb including servo amplifier and is housed in a cylinder of 6½in diameter and 13½in long. Accuracy of vertical reference is 0.2 deg and the random wander of the gyros is about 1 deg/hr. The Mk 2 is a private venture.

Displayed on the **Elliott Bros.** stand was the Air Data System incorporating static and pitot-static transducers and an air data computer providing voltage or synchro outputs for Mach number, height, vertical speed, indicated airspeed, true airspeed and temperature. The equipment is fitted in NA.39, Lightning and Meteor and Canberra drones. As well as supplying air data to any systems in the aircraft requiring it, the Elliott equipment operates height and true airspeed vertical tapes and a horizontal tape unit showing indicated airspeed and Mach number, together with a command Mach number value. An expanded arithmetic scale covers speeds from 80 to 150 kt, the scale being logarithmic thereafter. Elliott believe that a tape altimeter is quicker to read than a three-needle dial, but the R.A.F. has reverted to a dial instrument on the Flight Data System panel because pilots have found that a rotating needle gives a much more easily appreciated indication of change of height. Out of the corner of his eye the pilot can see the needle begin to wander as the aircraft departs from the required height. The ambiguity of the three-needle instrument has been overcome by providing only one needle moving against a scale marked from 0 to 10 representing hundreds of feet with intermediate marks at 50ft intervals. The complete height figure is shown in a veeder counter.

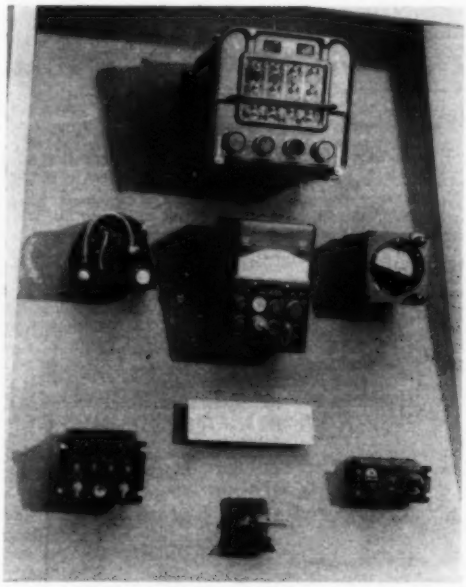
A new version of the Smith's Flight System designed for installation, with or without autopilot, in smaller transport aircraft, is the Flight System type 4. It provides full radio coupling and dual instrumentation for a total weight, with mountings of 59 lb.

Significant is the **G.E.C.** altimeter encoder in which height indications from the instrument are converted for transmission via transponder coding or Decca data link.

Simulators The latest trend in this field is a break-away from complete cockpits to special classroom simulators for individual systems in particular aircraft. **Redifon** exhibited one of these simulators produced for B.O.A.C. to illustrate the basic principle and operation of the Rolls-Royce Conway RCo.10 Mk 505 for the Boeing 707. Pilot's and engineer officer's controls and instruments are mounted on panels either side of a large pictorial diagram of the Conway engine, together with an instructor's faults console. In this way the effects of mismanagement or faults can be clearly illustrated together with the actual instrument indications and control responses. The company is producing a similar simulator for the P. & W. JT4A-3 engine for S.A.S. Complete flight deck simulators are being made for the Canadair CL-44 and the Westland Wessex. The swing to moving- as opposed to fixed-base methods continues and the Comet simulator for B.O.A.C. has "flown" 720 hr with only 80 minutes unserviceability. Vanguard, Caravelle and Convair 880 simulators respectively for T.C.A., S.A.S. and Swissair are to have roll, pitch and limited vertical movement—colloquially known as "rock, roll and heave."

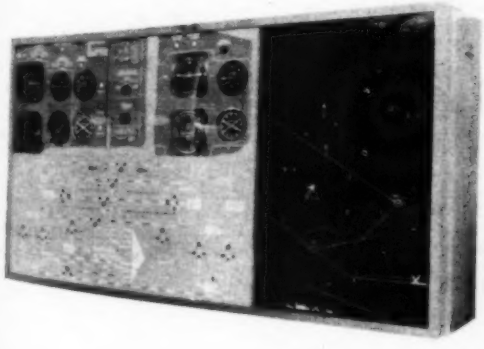
Air Trainers Link displayed an electro-mechanical classroom simulator illustrating in detail the functioning of the complete Bendix flight system instrumentation. Comet 4B and Vanguard moving-base electronic simulators are being produced and the company is preparing a low-cost four-station (I.L.S., N.D.B., V.O.R. and range) radio aids simulator for attachment to the standard Link trainer.

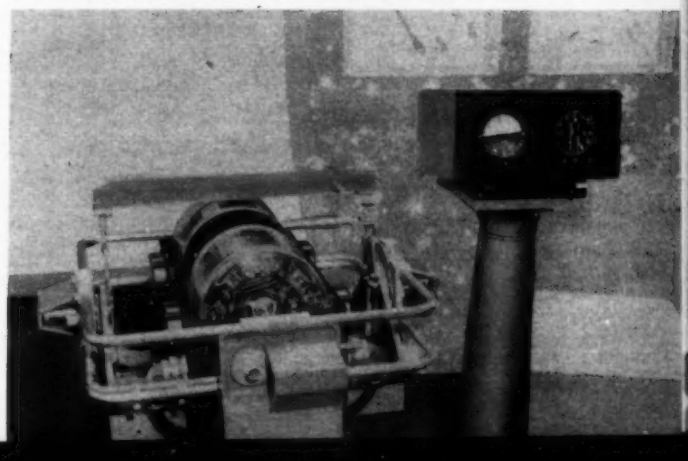
Classroom simulators for electrical, hydraulic and fuel systems might be produced, the object being to relieve the full flight simulator of basic work which can better be done in a classroom. In addition, maintenance engineers can also be trained.



(Above) Autopilot components by Louis Newmark for anti-submarine helicopters. They include, at right, a three-axis attitude indicator and MA.1 compass control panel. (Below) The new S. G. Brown master reference gyro Mk 2 operating a roller-blind horizon and a compass indicator

Air Trainers Link B.O.A.C.-classroom simulator for Bendix flight system. Command paths and aircraft progress are electrically lighted





AIR CONDITIONING

APPARENT among air conditioning displays at Farnborough this year was a trend towards vapour-cycle cooling systems, equipment for which was shown on the stand of every major air conditioning equipment manufacturer. Vapour cycle is necessary because air cycle systems can no longer keep pace with the more exacting demands of aircraft cooling systems.

The vapour-cycle system—similar in principle to the domestic refrigerator—has the ability to cool the flow of air to the cabin independently of the pressure at which it is supplied, and it has the further advantage that in cooling cabin air to very near freezing point it is possible to extract most of the moisture and so reduce cabin humidity.

The units shown had three major applications: for air conditioning large civil aircraft, supplying air within specific temperature and moisture limits to pilot's air-ventilated suits, and for cooling both aircraft and missile equipment.

Many of the firms showing vapour-cycle cooling equipment also displayed descriptive system diagrams by which the functions of the various units could be followed; although the basis of all systems is broadly the same it was clear that there are a number of ways of achieving a common end.

On their stand, **Normalair** showed a diagram of a vapour-cycle cooling system which they said is for use in aircraft "of the VC.10 type." It can be supplied as packs of 15-ton capacity or as an installation for locating in the wing root or in an underfloor fuselage bay. The total heat load of an aircraft such as the VC.10 would be about 36,000 B.Th.U. and two systems—one per side—would be required to provide adequate conditioning.

Normalair claim for vapour-cycle cooling that it is lighter than air-cycle systems and therefore has an advantage even when the latter could be used. A further advantage is that refrigeration can be provided when the aircraft is stationary with the engine stopped and that separate ground-conditioning trucks are therefore unnecessary. Normalair centrifugal compressors are driven by electric motors, but air turbines can be used and this should reduce the overall system weight. The company are offering a range of systems up to the size that might be required for a supersonic civil transport.

A vapour-cycle package for cooling airborne equipment was shown by **Sir George Godfrey and Partners.** This incorporates all the components of the refrigeration system with the exception of the condenser, which is installed in a remote position in the aircraft. The Godfrey unit is designed to circulate water/glycol as the equipment coolant; heat is transferred from the coolant to the refrigerant in the evaporator and is finally rejected to a cooling flow of ram air through the condenser. The compressor set consists of an 8 h.p. A.C. motor coupled to a screw-type refrigerant compressor. This package weighs 108 lb.

Another vapour-cycle cooling system, shown by **de Havilland Propellers,** employs a twin-cylinder reciprocating compressor driven by a swash-plate hydraulic motor. It is of a size suitable for supplying processed air to an air-ventilated unit or for missile cooling. A distinctive feature of the compressors is that they have been designed to run dry, so that oil separation is not a problem.

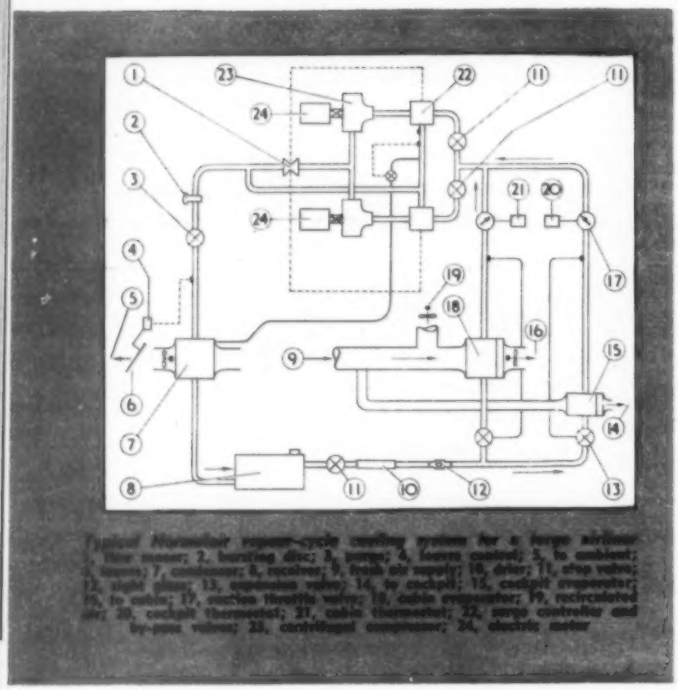
Although new cabin pressure control systems were not greatly in evidence this year, Normalair had a new design to offer—the "Multi-valve System." In operation it is almost completely automatic and the only two selections which have to be made by the aircrew are those of airport altitude. The advantages claimed for the new Normalair system are that the discharge valves are in parallel instead of series and that the design of the valves considerably reduces the back pressure of the system. Normalair claim that by this means surges in cabin pressure are almost eliminated. The new design of discharge valve functions as a safety valve and inward relief valve, reducing system weight to about half that of "comparable conventional installations."

Much has been seen in recent months of personal oxygen presentation systems. Normalair were showing a system of this sort and so were the **Walter Kidde Company** (who have been working in conjunction with **British Oxygen**). A brand new device on the Walter Kidde stand was an automatic crew oxygen system of the pop-out type. Should cabin differential pressure fail a new design of mask appears from a small box installed in the cockpit. This is in keeping with the philosophy that it is sounder suddenly to thrust an oxygen mask at a pilot when an emergency occurs than to introduce hard-to-enforce legislation that one crew member should wear a mask continuously.

A new cabin temperature control system from **Teddington Aircraft Controls** has been designed for the Handley Page Herald. It is a lightweight, simple, low cost layout with manually monitored duct temperature control, although this could be modified to a fully automatic system by the addition of further components.

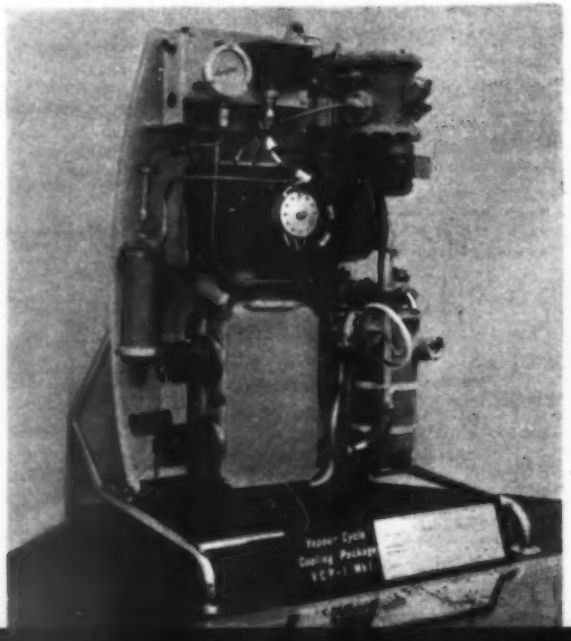
Another temperature control system, **shown by Armstrong Whitworth Equipment,** is intended for aircraft flight decks. It is designed to mix the hot air supply from engine blowers with cooling air from the cooling system.

(Left) Walter Kidde's new crew emergency oxygen mask with "pop out" action. (Right) D.H. Propellers' vapour-cycle air-conditioning system for missiles or for pilots' air-inflated suits



Typical Normalair vapour-cycle cooling system for a large airliner. 1, Hot supply; 2, bursting disc; 3, pump; 4, heater control; 5, to ambient; 6, heater; 7, condenser; 8, receiver; 9, fresh air supply; 10, drier; 11, stop valve; 12, sight glass; 13, expansion valve; 14, by cockpit; 15, cockpit evaporator; 16, to cabin; 17, suction throttle valve; 18, cabin evaporator; 19, recirculated air; 20, cockpit thermostat; 21, cabin thermostat; 22, pump controller and by-pass valves; 23, centrifugal compressor; 24, electric motor

Water/glycol equipment-coolant has its heat extracted in this Godfrey vapour-cycle cooling package



Round the Stands . . .

GROUND SUPPORT EQUIPMENT

THERE was more new ground-support equipment to be seen—mainly in the outdoor exhibition—than in previous years. In general, this review highlights the items which were making their debut, though certain equipment previously displayed is mentioned where it has been the object of considerable development.

H. W. Edghill showed a new development of their Autostair, the Mk III version of their self-propelled airliner embarkation steps, carried on a Commer Karrier truck. The example shown was for T.C.A. It had a hydraulically adjustable elevation ranging between 9ft and 13½ft approximately. New from **Rellumit** was a neat mobile hose elevator unit developed for Shell International Petroleum. It is designed to assist refuelling personnel to handle heavy loaded fuel hoses during the underwing fuelling of big aircraft like the 707 and the DC-8. One of the dominating exhibits in the outdoor exhibition was **Esso's** brand new Python fueller, a 12,000 Imp. gal giant weighing 26 tons empty and 75 tons laden, and measuring 55ft in length. It is claimed to be one of the world's largest articulated refuellers, and the trailer section was built by the **Steel Barrel Company** of Uxbridge. Delivery rate is 1,000 gal/min and it is claimed that a 707 can be refuelled in ten minutes by two Pythons.

Pyrene were displaying the newest version, Mk 7A, of their airfield crash tender, mounted on a Thorneycroft chassis and powered by a Rolls-Royce B.81 engine. The vehicle shown is one of a substantial number being supplied to the Canadian Government Department of Transport. Foam is discharged simultaneously from two four-inch lines, and discharge can be sustained for as long as required, since the tender can take on additional supplies of water and foam-compound without breaking the continuity of foam production. The vehicle incorporates a Thorneycroft-designed auxiliary drive which makes it possible for foam or water to be pumped while the vehicle is in motion. The vehicle can therefore change its position quickly in order to tackle the fire efficiently without interruption of the foam discharge.

Morfax showed their range of aero engine strip-build platforms and servicing stands, including a new roll-over servicing stand for the Tyne. In addition to their displays in the outdoor exhibition, Morfax again made available to aircraft participating in the flying programme the services of their mobile workshop. Facilities included sheet-metal work, "Argonaut" and argon arc welding, gas welding and cutting, and fluorescent crack detection.

Auto Diesels displayed their new 60 kVA 400 c/s ground power unit, designated G.P.U.7. It is trailer-mounted and has a diesel-driven alternator. It was built to M.o.S. contract and is supplied to the R.A.F. Also offered by this company, though not shown, was the new Aydee air starting unit fitted in a van as an alternative to the trolley-mounted version.

Well worth watching was **Palmer's** display of a brand-new type of passenger escape chute, as supplied to B.O.A.C. for installation in the Corporation's Boeing 707 fleet. Stowed near the passenger door, this chute is self-inflating and in an emergency landing can be launched for passenger-evacuation in an elapsed time of less than 25 sec. The chute can, if necessary, be used as a dinghy, and it is claimed to offer many advantages over non-rigid chutes which have to be located at ground level before escaping passengers can slide down them. The Palmer unit is stated to weigh 20 lb plus the weight of a small air bottle supplied pneumatic system.

H.M.L. Engineering's display included entirely new exhibits. One was the "Brill" light gas turbine (45/60 h.p.) used as the power unit for a cabin pressurization trolley developed for the

Dowty have been developing hydraulic wheel drives for tractors for over two years. This Dowty Transmatic-equipped David Brown tractor was lent to the S.B.A.C. for the duration of the Show

M.o.S. This delivers 1,000 cu ft/min at 15 lb/sq in. The "Basilisk," a larger gas turbine, can be used in air bleed form for engine starting at 2½ lb/sec at 60 lb/sq in, or to provide a direct shaft output of 500 h.p. at 1,500 r.p.m. It has a development power-potential claimed to be of the order of 1,000 h.p.

"The most powerful D.C. servicing trolley to date" was the claim made by **Houchin** for their ground power unit, new to the S.B.A.C. Display, developed during the past year and ordered by B.E.A. for their Comet 4B and Vanguard fleets. Primary power is supplied by a diesel engine coupled to 28.5 V generators giving outputs of 1,200 amp continuous (2,250 amp intermittent), and 112 V, 300 amp continuous (900 amp intermittent). The unit is mounted on a heavy-duty chassis with four solid rubber-tyred wheels with independent rubber suspension. It is not, for B.E.A.'s requirements, motorized. Also new from this firm is a smaller motor alternator set, the alternator giving an output of 500 VA at 115 V single-phase.

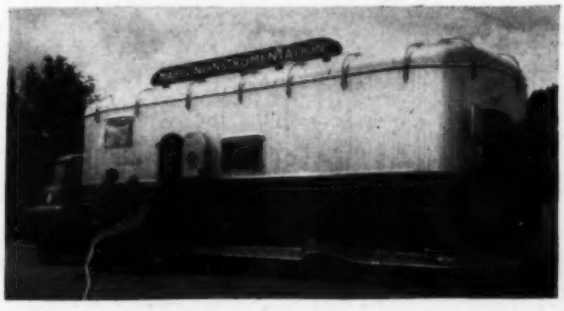
For the very first time **Dexion** were participating in an S.B.A.C. Display. The word Dexion has become almost a generic expression for slotted angle which this firm has made so successful, and a selection of the many different uses to which this basic constructional material can be put were exhibited on the stand. The use of Dexion for crates used in the air freighting business is reported to be increasing.

A new ground power unit was shown by **Rover Gas Turbines.** (This was in addition to their airborne 60-90 h.p. A.P.U.) The new unit, small and compact, is designed to be easily transportable and it can be used for ground servicing jobs requiring electrical power and low pressure air. The unit consists of a Rover 1S/60 gas turbine engine of 60 h.p., coupled to a Rotax 28 V, 300 amp D.C. generator. The weight of the unit is 500 lb; length and height are only 67in and 48in respectively.

Zwicky displayed a good year's development work: three completely new fuel vehicles shown were as follows: (1) The "Severn," as supplied to **Shell-Mex and B.P.**, a 10,000 Imp. gal monster mounted on an A.E.C. Mammoth Major Mk 3 six-wheel chassis. Refuelling rate is 750 gal/min and it is claimed that the 2.22 : 1 ratio of laden to unladen weight is much superior to the average of comparable vehicles. (2) The "Super Jet" dispenser, designed to dispense fuel from hydrant systems to DC-8s and

Shell's Severn refueller was a giant among the outdoor exhibits. It is the first of five 50-ton superfuellers which are to be used at London Airport, particularly for replenishing the heavy jets

Telecommunication measuring equipment was on display in this mobile display unit supplied to Marconi Instruments by Coventry Steel Caravans. Later it will tour Europe



Not fitted with guns, the de Havilland Sea Vixen FAW.1's internal armament comprises hinged packages each housing tubes for 14 spin-stabilized 2in rockets. A further four packs, each of 24 rounds, are here slung from pylons. Made by Microcell, these containers have been proved during high-speed air firing

Round the Stands . . .

Boeing 707s was shown developed for **Air B.P.**, and was mounted on a Karrier Gamecock chassis powered by a light diesel engine. (3) The "Tagus" hydrant dispenser was shown for the first time, as supplied to **Shell Petroleum.** This neat little unit has been designed also for fuelling from hydrant systems, and the dispensing equipment, with as large a capacity as 600 Imp. gal/min, is mounted on a Bedford 10/15 cwt C.A.Z. chassis.

Not shown before by **Blackburn** were a turbo-starter Commer truck and a Commer trailer. In the truck is fitted the Blackburn Palouste 502 power pack, and in the trailer was installed the Artouste 510 power pack. Thus these two well-known units are now available in self-propelled mobile form, either as a trailer or as a truck. It was interesting to note that the body of the trailer was in effect identical with that of the truck.

New from **M.L. Aviation** was an extremely neat multi-purpose handling trolley, now in production for the Royal Navy. Operating on the lazy-tongs principle, controlled by two independent hydraulic jacks, it tilts fore and aft, moves transversely and has limited movement in yaw and roll. It can be used for offering up or detaching almost any kind of underwing store. Its maximum load is 3,000 lb. For the purposes of the display the store mounted on it was a **Bristol** plastic drop tank.

Foamite were showing their new "Fireball," a dry-chemical extinguisher, the body of which is an all-welded steel sphere containing the powder charge. This design achieves a very low c.g., permitting the extinguishers to be moved about by hand very quickly and easily without tipping. The Fireball has a discharge rate of 150 lb/min and an effective range of 30-35ft. Also not seen before were two tenders based on an Austin Gipsy chassis, one for dry-powder fire fighting, the other equipped for water/foam extinguishing.

Vernons had two exhibits new to the display: trailer-mounted and self-propelled aircraft ground power units. Both are being supplied to B.O.A.C. for servicing the Corporation's 707s. Diesel-powered A.C. supplies are at 400 c/s per second and brushless alternators were a noteworthy feature.

Some of **Sir. George Godfrey and Partners'** larger equipment could be seen on the stand outdoors. New this year was (1) A vapour-cycle servicing trolley, a private venture for servicing cooling packages; (2) A missile-conditioning system developed for English Electric; and (3) the LEAP. The two last-named are described in the section dealing with weapons.

Lucas-Rotax were showing their new sectional fuel system test rig. These sectional rigs are offered—like domestic sink units—in sections: only one rig, usually the pump rig (the type displayed was R.393), forms the main driving unit for others which can be added to it to form one large composite rig. Alternative types are available to meet the requirements of different aircraft fuel systems.

Airtech showed for the first time their new air transportable containers. The "Aircon" has been developed to meet the demand for complete installations and equipment (e.g., workshops, telephone exchanges, laboratories, communications units) to be readily transported by air and to be in operation as rapidly as possible. Detachable end-walls allow large equipment to be installed, and a chassis unit can be fitted for surface mobility. This is in two sections which can be easily clamped to the sides of the Aircon while it is on the ground. The wheels are raised and lowered by hand-operated screw-jacks. The Aircon can be transported by helicopter. The "Aircon B," which was also displayed, was specifically designed for transporting in R.A.F. Transport Command's Britannias.

New on the **Delaney Gallay** stand was a compact portable welding kit, a self-contained unit designed for welding stainless and mild steels of all thicknesses up to 22 s.w.g. The electrode can be used in two ways—mounted in a hand gun operated by a trigger switch, or by itself as a pencil electrode with a foot switch. The unit is known as the Incorporall.

Shown for the first time at Farnborough was a 35ft articulated unit which **Marconi Instruments** use to demonstrate their telecommunications-measurement instruments, particularly oscilloscopes, to instrument users. This mobile showroom will undertake a four-month tour of Western Europe next year. The unit itself (supplied by **Coventry Steel Caravans** of Newport Pagnell) is large enough to form an upstairs office which can be used as the manager's room, or if necessary, for emergency living accommodation.

Coupled for "gang operation" was the **Lewin Sweepers'** runway sweeper/collector. Designed to meet the demand for runway cleansing in the jet age, to minimize engine debris-ingestion damage, the coupled sweeper units give a total swath width of 20ft. Among the new products shown by **Simmonds Aerocessories** was a fuel dispensing unit designed for operation with hydrant systems. Mounted on a self-propelled chassis, it is capable of dispensing 500 Imp. gal/min through twin hoses. It is fitted with a "Fram" filter/water-separator, fuel meters and pressure controller. The unit can be supplied as self-propelled or as a trailer, and is built under licence from Pryor Manufacturing Co., of Mansfield, Ohio.

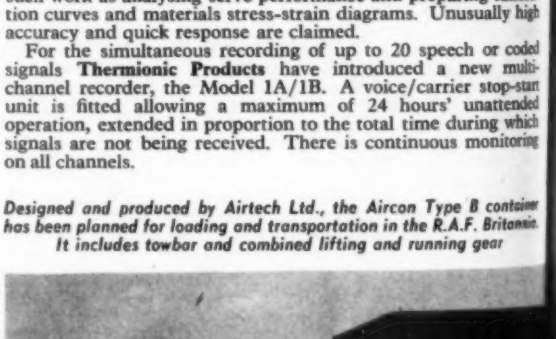
Not all the ground support equipment was displayed in the outdoor exhibition. The indoor display contained a number of new or developed ground support ancillaries of smaller dimensions. Picked out was **Avery-Hardoll's** completely new LBM.1000 bulkmeter, with a rated capacity of 1,500 Imp. gal/min, compared with the 650 Imp. gal/min offered by the company's previous largest bulkmeter, the BM.600. The new meter has been designed for high flow rates, including bunkering with heavy fuels; it is equally suitable for light petroleum products.

New at the display from **Goodman's Industries** was a complete vibration testing system incorporating a 10,000 lb thrust vibrator driven from an automatic oscillator providing the input to a 2 kVA powered amplifier used to drive the vibrator (normal power requirement is 20 kVA; 2 kVA was used for demonstration purposes). The amplifier was one of a new range offered by this company to cover output power levels from 30 kVA down to 5 kVA.

An addition to the range of test and research equipment in which **Bryans Aeroquipment** specialize is an "X" and "Y" co-ordinate plotting table, a portable and self-contained aid to such work as analysing servo performance and preparing calibration curves and materials stress-strain diagrams. Unusually high accuracy and quick response are claimed.

For the simultaneous recording of up to 20 speech or coded signals **Thermionic Products** have introduced a new multi-channel recorder, the Model 1A/1B. A voice/carrier stop-start unit is fitted allowing a maximum of 24 hours' unattended operation, extended in proportion to the total time during which signals are not being received. There is continuous monitoring on all channels.

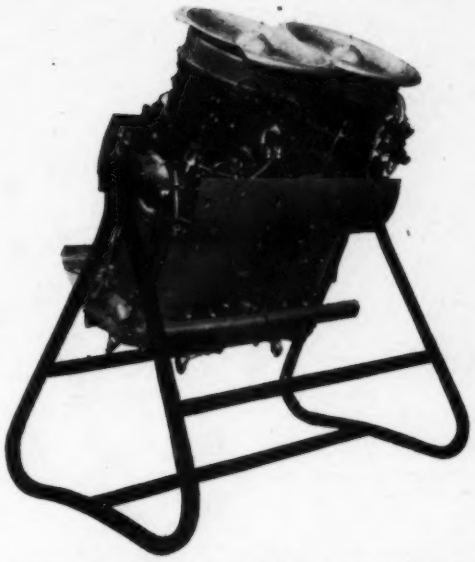
Designed and produced by Airtech Ltd., the Aircon Type B container has been planned for loading and transportation in the R.A.F. Britannia. It includes towbar and combined lifting and running gear



An eighth-scale model of the latest addition to the family of jet engine test stands manufactured by **John Curran** was displayed for the first time; designated Mk 1C, this has a capacity for engines of up to 30,000 lb thrust and it was specially designed for checking Rolls-Royce Conways and Pratt and Whitney JT3 and JT4 turbojets. The first example will be supplied to Rolls-Royce's new overhaul factory in Brazil, and two other units are in production for the Indian Air Force and South African Airways. An example of a new range of inexpensive classroom training aids for airlines, by **Air Trainers Link,** was new to the display. Developed in co-operation with B.O.A.C., the example shown was concerned with the Bendix Flight System of the 707.

Royston Instruments showed a new kind of fault-finding equipment for airline maintenance departments, used in conjunction with the company's Midas flight and crash recorder (also displayed). It is claimed to be simpler and cheaper than other larger play-back equipment. Its purpose is to permit maintenance staff quickly to detect and deal with faults which have developed in flight. A cassette from the flight recorder is taken out of the aircraft, the tape is rewound to a point in time (G.M.T.) where the pilot has reported the trouble, and the recorder is then re-played. Simulated readings of the instrument are reproduced and a ground engineer thus has a complete picture upon which to base his diagnosis.

Templewood Hawksley, a member of the Hawker Siddeley Group, and who have taken over the design, development and manufacture of airline servicing units formerly dealt with by **Air Service Training,** have supplemented the existing range of A.S.T. equipment. New products include an improved version of the Mk 4 servicing trolley with a higher capacity for the big jets. New heavy-duty servicing units and water carriers are also to be put into production as self-propelled units.



The four lift-engines of the SC.1 are Rolls-Royce RB.108s arranged in twin packages which tilt 30 deg fore and aft

POWERPLANTS

PROBABLY the most significant development in aircraft propulsion in recent years is the evolution of the double-flow turbojet as an intermediary bridging the gap between the turboprop and the turbojet. The manner in which this has come about is well known: after initial exploration by such companies as Turboméca and Metrovick, Rolls-Royce established the first standard with the Conway (which they have always described as a by-pass turbojet), the thrust of which has risen from 9,250 lb to 18,500 lb since 1953. Commercial sales won by these engines in 1956 spurred the two largest American companies to produce "fan" derivatives of existing straight turbojets.

Today, the position is clarified. While the first-generation American fans come near to entering service both Rolls-Royce and Bristol Siddeley are actively developing families of entirely new powerplants utilizing the double-flow principle. Both firms are at pains to point out that their new engines are based upon clean sheets of paper and are in no way compromised by having to incorporate parts of earlier engines; yet at the same time Bristol Siddeley at least stress that many of the most critical items in their new fan engines are "identical or similar to those used in earlier designs which have completed many thousands of hours in service."

First details of the **Bristol Siddeley BE.58** were given in our two previous issues. These figures may now be expanded to the following: sea-level thrust, 14,500 lb with s.f.c. of 0.572; s.f.c. under cruising conditions at 36,000ft, 0.8 ("at least 10 per cent lower than that of the most efficient current turbojet"). Dry weight is 2,600 lb. It remains to be seen what mechanical configuration has been adopted. The alternatives are: single shaft; twin shaft (which may be regarded as a straight jet with a mechanically independent low-pressure assembly comprising a turbine driving a two-stage fan), and split compression, in which the fan is formed by the first two stages of the low-pressure compressor having extended blading. Bearing in mind the likelihood that major portions of the rotating assembly are derived from the Orpheus and Olympus, the third alternative seems the most likely. The cold-flow ratio is known to lie between 1.5 and 2, suggesting that the engine is matched to propulsion of transport aircraft at Mach numbers of not greater than 0.9.

Compared with the Bristol Siddeley fans, the **Rolls-Royce RB.141,** progenitor of a complete family, has a lower cold-flow ratio, resulting in an engine of higher fineness ratio. Rolls-Royce have stated that they are aiming particularly at thrusts between 10,000 and 17,500 lb as being most suitable for the propulsion of the next generation of airliners. So far, financing of the family appears to be entirely by the company. The two engines most likely to reach a state of early commercial availability are a 14,300 lb thrust RB.141 and a 10,100 lb thrust RB.163, respectively for the advanced Caravelle and the Airco D.H.121.

The slimness of the RB.141 (displayed at Farnborough as an engineering mock-up) should significantly reduce the momentum drag and increase the net effective thrust imparted to the airframe, especially at take-off, in comparison with a fat fan engine. In the RB.141 engineering mock-up (presumably for Sud Aviation) the accessory package was mounted on the underside, seemingly more logical than the dorsal mounting on the BE.58.

Compared with the new family of "optimum" commercial engines the existing **Conway** family have a rather lower cold-flow ratio; although their economy is nevertheless appreciably better than that of the straight turbojets with which they have competed for business (as the measured performance figures for the Boeing 707-436 substantiate). It is an index of the quality of Rolls-Royce engineering that, although until recently Conway flight-time was severely limited, development has surpassed all expectations.

Clearance of the commercial units at 17,500 lb has been achieved from 12 to 18 months ahead of schedule; Mks 505 and 507 (Boeing and Douglas respectively) are being delivered in quantity at 16,500 lb guaranteed minimum dry, with approval at 17,000 lb; Mks 508 and 509 (Boeing and Douglas) are virtually identical at 17,500/18,000 lb; net dry weight is averaging some 140 lb below the guaranteed figure; engines have already been run at over 19,000 lb dry and appreciably higher ratings are planned. For commercial operations, increased power will confer much-needed improvement in field performance, and in any case it is likely that the Vickers VC.10 is being planned around a Conway more powerful than those currently being delivered. For military applications the RCo.11 (17,250 lb dry) is being delivered in quantity for the Victor B.2, and Rolls-Royce have now made reference to the possibility of producing a fighter Conway with a thrust of 30,000 lb burning additional fuel in the by-pass air.

Permission has been granted for publication of the configuration of the main rotating assemblies of the current Conway. The RCo.10 and 12 (Mks 505-509) utilize a seven-stage low-pressure compressor, a nine-stage high-pressure compressor, a single-stage high-pressure turbine and a two-stage low-pressure turbine. The pressure ratio may not be quoted, but it may be recalled that the Tyne, the pressure-ratio of which is 13 : 1, has a six-stage l-p. compressor and a nine-stage h-p. compressor; and it has been suggested that the h-p. spool of the Tyne is scaled from that of the Conway.

It must be recorded that certain markets for the **Napier Eland** have failed to materialize in the manner hoped. Nevertheless, as a straightforward engineering product the engine has progressed excellently; it is insufficiently appreciated that it has been fully certificated to the new ARB/CAA schedule (and was actually the first turboprop in the world to achieve this distinction), and has for some time been carrying fare-paying passengers. The operator involved is Allegheny Airlines, using a CV-540. During the summer some unfortunate service delays were caused by bearing failures, and Allegheny were forced to use other equipment while the problem was investigated. It was traced to brinelling of the races during air/road shipment of the powerplants from the United Kingdom, and the new transport stand—displayed at Farnborough—incorporates rubber-in-compression shockproof mountings which seem to have made brinelling a thing of the past.

Although it has yet to fly, the **de Havilland Gyron Junior DGJ.10R** (10,000 lb dry, 14,000 lb with afterburner) may be regarded as already in a very advanced state of development owing

Engine condition analysers for gas turbines. (Above) Ultra Electric's unit shows temperature indications in the upper cathode-ray tube and vibration in the lower. A separate unit, the scanner, which is fixed in the equipment bay, is not shown. (Right) The two units of the Elliott-Bendix monitor. Temperature and vibration safety limits are indicated by red and green points on the oscilloscopes

Round the Stands . . .

to the fact that it incorporates major portions of the earlier Juniors. Flight development of the 10R is to be conducted by units mounted in a Javelin, the conversion having been effected by Napier's Flight Development Establishment at Luton. But for certain mechanical snags, particularly in the cockpit/powerplant linkage, this aircraft would already be in the air. (So great is the thrust of its new engines that full reheat will be permissible only during a steep climb.) The 10R has been selected to power the Bristol T.188 research aircraft. This will be the fastest, and highest-flying, British aeroplane, and D.H. Engines are having to clear this type of Junior over an extreme range of ambient conditions. The actual engine exhibited at Farnborough is about to undertake reheat running in a high-altitude tunnel of the N.G.T.E. at Pyestock.

Powerplant Accessories This year, for the first time, a number of gas turbine engine analysers were on show. These are the gas turbine counterpart of ignition (and hence performance) analysers with which many recent piston-engine powered aircraft have been equipped. **Sperry** showed a pair of vibration sensers—transducers for mounting at suitable locations on the engine—to measure vibration and pass information back to a cockpit recorder. A Bendix-Scintilla Engine Monitor was shown by **Elliott Brothers,** whose Engine Accessory Division are constructing it under licence, and a further unit was shown by **Ultra.**

Both vibration and front and rear bearing temperature are recorded by the Elliott Monitor and presentation of this information is on a pair of rectangular-faced cathode-ray oscilloscopes. A rotary switch constantly sweeps sensors on the engine, and information is passed to the scopes in the form of a trace. Temperature information is presented in a similar fashion and the actual temperatures in any particular engine can be determined by setting the zero on a scale on the oscilloscope face over the electronic trace. This is done by first selecting the engine which is to be examined and then turning the scale setting knob; this has a veeder counter immediately above it and the figures which appear give a direct reading of temperature.

Broadly similar in principle is the Engine Condition Analyser shown by Ultra. Temperature information is obtained from up to 40 thermocouples situated in the combustion system. These can give warning of hot or cold spots due to faulty burners or other causes, and the same information can be used to indicate consistency of combustion both during the starting cycle and normal running. Information on vibration is given to the first order of amplitude. Two cathode-ray tubes again form the basis of the display; the upper one shows temperature and by actuating a control switch the full width of the screen can be used to show the ten temperature points of an individual engine. Two horizontal lines across the screen are a temperature base line and a calibration line; the former is fixed in any one of four positions (selected by a switch) which, when the engine is functioning correctly, should pass through the mean of the engine temperature indications. The four positions are calibrated for the particular engine and represent take-off, climb, cruise and decent temperatures.

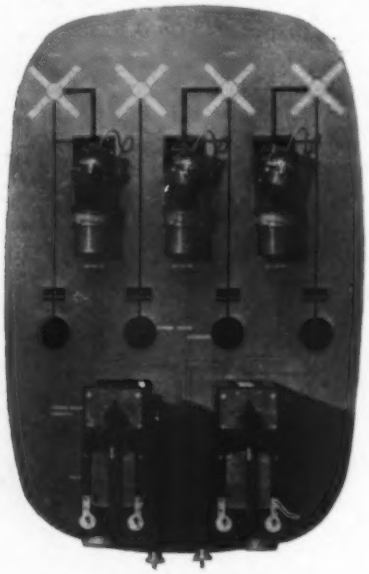
Two units, a scanner and display, comprise the analyser and they weigh respectively 8 lb and 5 lb without cables.

About two years ago **British Thomson-Houston** and **Hobson** put up proposals for aircraft starting, using an A.C. alternator and constant-speed drive as the starting unit, and B.T-H. have continued development of an electrical machine—a 50 kVA starter-alternator with a constant-running speed of 8,000 r.p.m.—for this purpose. It is shortly to be run on the bench with a Hobson drive as a preliminary to further trials. There is admittedly some prejudice on the grounds of possible unreliability against electrical starting, but where a self-contained start is required the alternator-starter system operating from an auxiliary generator power unit is competitive with air starting systems and it may well have advantages in weight and space. Since the proposal was first made, the Hobson unit has been redesigned on a different operating principle, but the new drive can now be offered with alternator starting facility. Meanwhile, B.T-H., who manufacture a range of D.C. electric, iso-propyl nitrate and cartridge starters, are giving design attention to air starting.

Quite a large number of fuel flowmeters are now on offer to the industry. Some of the firms engaged are **Negretti & Zambra, Integral, Firth Cleveland, Armstrong Whitworth Equipment** and **Elliott Brothers.** Integral's flowmeter has now been in production for some while, and like Firth Cleveland's design utilizes a flow transmitter and electronic integrator. Both the Armstrong Whitworth (Gloster Technical Developments) and Elliott designs function by importing angular momentum to the fluid by a closely controlled constant-speed motor and extracting and measuring this momentum by using it to deflect a turbine against a spring. The Elliott flowmeter is a Bendix design to which Elliott are adding an integration system incorporating an A.C. pick-off and amplifier which will give a gallons gone presentation. The Armstrong Whitworth true mass flowmeter is now in the final stages of development, but it is likely that a new intermediate size may be introduced that will be suitable for Dart engines.

de Havilland Propellers had new propellers on show, the 16ft four-blader of the CL-44 and the small propeller for the Gnome. The company also displayed their synchrophasing system. This is a useful way of reducing noise and vibration and can materially improve passenger comfort. Three phase-signals from alternators on the master and slave engines are compared and any difference in speed or phase displacement is fed into the positional servo control of the slave actuator to bias the propeller controller.

Illustrated diagrammatically is de Havilland Propeller's automatic synchrophasing system. It consists of three actuators connected to the slave propellers and the computer seen at the bottom of the picture



Round the Stands . . .

FLYING AIDS (Radio and Radar)

Typical of modern production trends are these largely transistorized communications, V.O.R. and I.L.S. radios, selectors and indicators of the Standard Telephones STR.23/34/35/36. They are in ATR cases

THE first thing to be noted about the radio side of this year's Show was the evidence of continued, vigorous development of the electronics hardware for the modern transport aeroplane. From the small beginnings of a couple of years ago there was a preponderance this year of types of airborne equipment embodying the best in the reliability engineering art with the all-important benefits of small size and weight. And the things to be seen were not the promise of good things tomorrow; they are the equipments which can be specified for the aeroplanes now on the order book.

Two other trends were to be remarked, each in its different way a sign of the times. One was the continued simplification of airborne radio equipment for pilot-operation and the second was the evidence of general and progressive adoption in the industry of the U.S. packaging and installation standards for airborne units. This step, none the less welcome even if it is overdue, must greatly help both the aeroplane builder and the equipment manufacturer and will demolish at least one barrier against the marketing of British radio equipment to the foreign air carrier. Several manufacturers had examples of this.

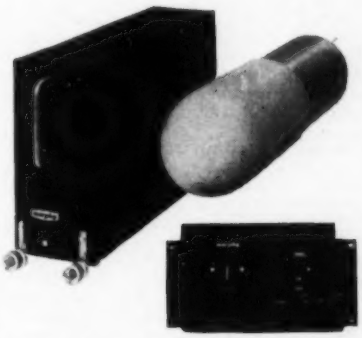
Whilst mentioning these steps towards transatlantic standardization, a welcome must be extended to **Elliott Radar** and **Telecommunications** sections, whose stand demonstrated on the one hand the extent of their committal to the airborne electronics field in this country and on the other, the potential of their relationship with the U.S. Bendix organization.

Three firms, **Smiths Aviation Division, Murphy Radio** and **Standard Telephones and Cables** had joined with M.o.S. to exhibit "Autoland." This is the auto-flare and blind landing system which has been developed by the Blind Landing Experimental Unit. The work of this unit has been described previously in *Flight* and this Show marks the commercial début of some of the devices needed for the job. Although happenings in the international arena make it unwise to prophesy an easy road to international standardization for this first-class British development, there does not in this case seem to be any reason why Britain should not "go it alone." Great benefits in the shape of progressively reduced landing limits, even if restricted for the time being to U.K. airports, could be earned by British operators for a relatively small price to be paid by way of airborne provisions. Conviction about a worthwhile step in aviation would grow very rapidly if airline A was landing and B was not!

The last year has seen spectacular advances in the design of the **Ekco Electronics** airborne weather radar. The new radar retains the essential operational features of its predecessor, i.e., 150-mile maximum range, high-brightness display, high-accuracy stabilization and alternative beam-switching for cloud avoidance and terrain-mapping, but great reductions have been made in weight and complexity. A substantial re-design of the equipment around transistors, printed connections and a new 18 kV display tube, have brought this about. The technique used, allied to re-arrangement of the equipment to concentrate the electronic circuits into a lesser number of units, has produced an equipment now weighing only 56 lb—which is much below anything else on offer today. By way of example, the transmitter-receiver unit, housed in an Arinc short ½ ATR case, weighs 19 lb. The display unit with all controls and some of the circuit components is housed in the Arinc standard dimensions for these indicators and weighs 14 lb. This new radar must be counted a major achievement. One further feature must be mentioned. Nose radars have now become near-mandatory equipment on all high-performance civil transport aircraft of any size. The new Ekco radar caters for duplication of the essential units of the system. Retaining the single 24in scanner, a twin-installation will now come to about 100 lb installed weight and this is a good deal less than some conventional single installations in use today.

Ekco were also displaying two transistor invertors each in a short ½ ATR case. Output ratings are 75 VA and 150 VA at 115 V A.C. 400 c/s. These are high-efficiency units for replacement of rotary machines in aircraft equipment power supplies.

A newcomer shown on the Standard Telephones and Cables stand is the DU.5 aeronautical general purpose V.H.F. transmitter and its associated receiver the RX.20. The DU.5, which is a 50 W crystal-controlled A.M. transmitter operates in the band 100-118, 117-156 Mc/s and employs only eight valves. One hundred and twenty-eight of these transmitters have been ordered by the M.T.C.A. for general use in the air traffic services. The RX.20 is a single channel crystal-locked receiver covering the frequency range of 100-156 Mc/s and has selectivity for 50 kc/s channel spacing. Output arrangements provide for feeding remote operators' position via telephone lines. A transistorized amplifier is available for loudspeaker operation. The design of both the DU.5 and RX.20 makes routine maintenance a very simple matter.



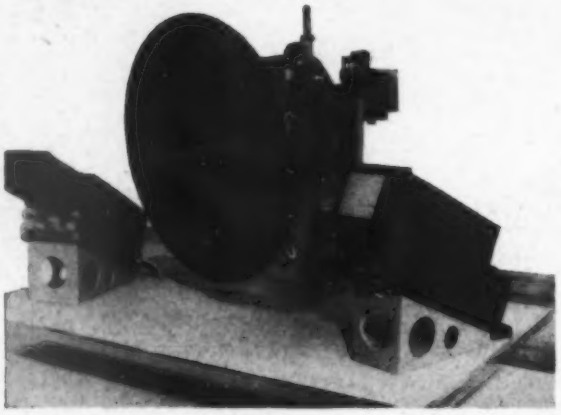
Murphy Radio leader cable receiver for Autoland with control panel incorporating in-flight test switches

Congestion and confusion in V.H.F. communications may be alleviated by the use of double channel simplex (DCS) working in which the receiver is separated from that of the transmitter by a few megacycles. This facility is provided by the STR.12F, a new version of the well-known STR.12 series of V.H.F. airborne equipments. This set also provides 280 channels at 50 kc/s spacing and has an A.C. blower supplied from the transistorized power pack which operates directly from a 28 V supply. A 19 V control unit can be provided to enable the equipment to be completely interchangeable with an STR.12D in an existing installation.

Exhibited for the first time last year and currently undergoing flight trials in B.E.A. de Havilland Comet 4Bs, three outstanding airborne equipments, the STR.23/34/35/36 V.H.F. communication and V.O.R./I.L.S., the STR.18C1 H.F. and the SA.10 audio distribution and inter-communication are on show again. The fully transistorized SA.10, now type-approved, was demonstrated with signals fed from the two communication equipments and from two simulated markers.

Because of the vital part it plays in the British automatic landing development, the sub-miniature altimeter exhibited by Standard Telephones and Cables rightly aroused renewed interest. The equipment, which has been ordered in quantity by M.o.S., employs transistors and printed connections, has an accuracy of ±1ft at touch-down and will be used to operate height switches and supply flare-out guidance in a comprehensive landing system. It is understood that a single range, simplified version in Arinc styling for civil use is to be produced. The transistorized counter unit is housed in a ½ ATR half-height case—the first British example of half-height ATR form factor permitting pick-a-back racking of miniaturized equipment.

(*Continued overleaf*)



The remarkable Ekco E.190 miniature weather radar which has 150 miles range and weighs only 56 lb. A duplicate version would weigh approximately 100 lb

Round the Stands . . .

Time sharing D.F. bearing-display equipment is demonstrated in operation. By electronic time sharing, simultaneous presentation of D.F. bearings from two separate channels or equipments can be displayed on one cathode-ray indicator type A.2208. For identification purposes, the two traces on the c.r. tube, representing bearings of two aircraft, appear as continuous and interrupted (dotted line) radial lines.

A series of colour transparencies illustrated the main features of the new STAN.7/8/9 ground I.L.S. installation. The improved performance claimed for the equipment over currently installed types stems from the use of a composite localizer aerial which substantially reduces site effects. The design of this aerial is based on the principle that the narrow beam radiations of the course (directional) array are unlikely to encounter any reflecting objects while its secondary lobes are effectively masked by the radiations of the clearance array. The design of the equipment is based upon the established Federal Telephone and Radio Corporation's AN/MRN7-8. Every advantage has been taken of the benefits to be derived from the use of transistors and as a result there are only 28 operating valves for a dual localizer and glide-path installation. The first equipment is currently undergoing evaluation trials for M.T.C.A. at Hurn Airport.

The newcomer to the range of standard civil aviation V.H.F. communication and navigation equipment was shown by Elliott Brothers. Styled the "21 series" equipment, it is truly contemporary in design, uses transistors and printed connections and offers the full range of facilities in the communication, V.O.R. and I.L.S. bands. The equipment is very light and compact and is noteworthy because it is not merely based on the current Bendix V.H.F. design, but is in fact a British-produced copy and interchangeable with the American product. The high degree of transatlantic standardization in components has allowed this to be done.

Another example of this unique treatment was the Elliott airborne weather radar. This is the widely used Bendix RDR.1D in British guise and provides the operational features now well established by practice in the civil nose radar field and largely common to both British and American makers of this type of airborne equipment. The weight of the equipment as shown was 83 lb and a drift measuring facility is available. For their first showing the company also had their aircraft intercommunication and facility selection equipment and a passenger announcement system. Both equipments use transistorized amplifiers in the local station units, obviating the need for central amplifiers and producing other consequential savings in cabling weights.

A system of secondary surveillance radar has been adopted internationally now through I.C.A.O. for use in air traffic control. **Cossor Radar and Electronics** have played a leading part in this notable achievement and were displaying this year the airborne and ground counterparts of this important international development. The ground element, the SSR system type 4G has been developed for M.T.C.A. to meet the design requirements of the I.C.A.O. standards for the A.T.C. system and includes the all-important side-lobe suppression feature. Both the directional and omnidirectional radiation patterns are produced by a 30ft aerial, the drive of which can be either independent or slaved to a primary radar. Again, the SSR transmitters can be set to run independently or to accept a trigger from a primary radar. These features give great versatility to the equipment and enable it to be used as a logical extension to existing traffic control radar units. The Type 4G can be ordered for either static or vehicle installation. The airborne transponder equipment for this secondary radar system is the Cossor SSR.1251, which has been designed to meet the international system specification and the Arinc characteristic. The design is around transistors for the pulse-switching circuits and magnetostriction delay lines for the encoding and decoding circuits. These techniques give low power consumption, a weight of just over 20 lb and packaging in a long ½ ATR case size.

In addition to their secondary search radar system Cossor were again showing their comprehensive and versatile display system Type CRD.23. This is a system of optional units adaptable to any particular purpose and to any combination of search and fixed-feature display facilities that may be demanded by an air traffic control complex and capable of expansion or modification as the need changes. The basis of the CRD.23 is a fixed-coil deflection system and uses the idle time between transmission pulses to graft in the desired information from external sources. This display system was shown with the company's CR.787 surveillance radar and, of course, it can be associated with the secondary radar system. Also on show was the S-band windfinding radar to be used in conjunction with free balloon ascents. Aerial alignment is joystick-controlled, alignment errors being shown on a cross-pointer instrument and a helical scan is used for initial target-finding purposes.

The decision of the I.C.A.O. special meeting this year on air navigation aids is now history; it rejected Decca and added the Tacan-compatible D.M.E. to the standard V.O.R. Such was the demand of the U.S. "Common System." This decision is not a final act—the I.C.A.O. Council must ratify it. Whether they will do so after a conference which divided so bitterly over a major issue in civil air transport is yet to be seen. Certainly there is no precedent in I.C.A.O. to suggest that the upsetting of the decision is likely. And that it is not simply a case of one navigation system

The Standard Telephones sub-miniature radio altimeter with its two suppressed horn aerials. The counter unit at left is the first British half-height ATR unit allowing pick-a-back rack-mounting

invented in the U.S. versus another developed in the U.K. must never be forgotten. It is a matter of a completely fresh start, no less, in the whole business of designing the technical support structure upon which high-density operations rest.

Notwithstanding the I.C.A.O. actions, the practical evidence from operations accumulates that sooner or later there will have to be a major change. The very pressure of the economics of the business of day-to-day operations of jet aircraft will compel this.

Whatever the rights and wrongs of the issue, the **Decca Navigator Company's** exhibits at the Show, coupled with the development programme they have under way, demonstrate that they have no hesitation whatever about continuing their work on Decca and its long-range counterpart. Their principal exhibits this year were of equipments engineered to the Arinc standards and included the Mk 10, the Mks 8 and 9 lightweight sets and the Dectra receiver. Both the Mk 8 and lightweight Mk 9 receivers are produced for small aircraft. One of them has been designed by Bendix for use with Mk 10 chains and operates with pictorial display on the lane identification pattern. It has a weight of 21 lb. The other lightweight set is based on the existing Mk 9 receiver and in contradistinction to the Mk 8 works solely on the integrating patterns with inbuilt safeguards against lane slip. This weighs a fraction under 21 lb. Supporting these products already available goes a comprehensive development programme of which one

of the chief items is a new attack on the Flight Log aimed at still further reducing the need for pilot manipulation. The computer for this new display produces rectangular co-ordinate information from the Decca signals in binary digit form. The chart itself carries binary code markings which are searched by an optical system, the output of which is continuously compared with that from the computer and error signals are derived to drive the chart and pen to the correct positions. The display is thus a self-setting one. Other developments include transistorization and miniaturization of the airline Mk 10 set, automatic monitoring of the autopilot using Decca derived information on a selected track, a position transfer system to give automatic position reporting over a digital-coded data link and, of course, further expansion and refinement of the Dectra system.

In addition to the B.E.A. Viscounts, operational flight work with the systems now includes a number of B.O.A.C. Comet 4s carrying on the work started in their DC-7C aircraft and it is understood that PanAm will be fitting a Boeing 707 later this year and that K.L.M. will be continuing their assessment, too. There can be no doubt about the vigours of these activities.

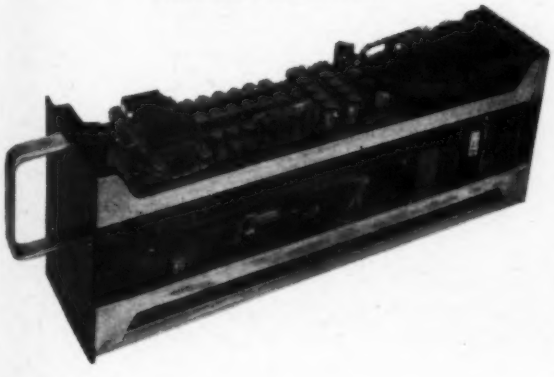
Marconi's Wireless Telegraph Company, associated as in past Shows with their Australian and Canadian associates, **Amalgamated Wireless (Australasia)** and **Canadian Marconi Company,** had a representative selection of the equipment they produce in a very broad coverage of the air radio field. Their exhibits ranged from the high-powered, combined S- and L-band radar S.247, the nodding height-finder S.244 and the 50 cm S.264 types which were demonstrated last year in an operations room simulation and this year in scale model form, to the tiny and widely acclaimed AD.712 A.D.F. The S.264 radar has evolved from the 50 cm radar which has been at work at London Airport for some years now and the first S.264 is now in service at Jersey Airport. These equipments will be remembered for their highly stable displays, effective M.T.I. and ability to see through rain.

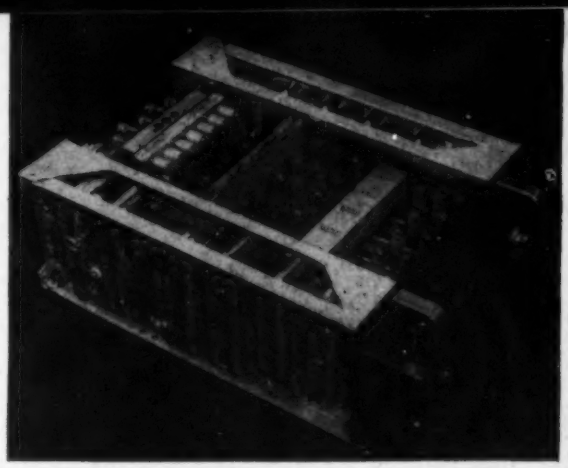
Pilots have welcomed the AD.712 in the warmest terms and it is now virtually established as standard equipment in all British transport aeroplanes of recent introduction and will be on B.O.A.C.'s Boeing 707s.

Chief interest in the Marconi display must, however, go to the civil transport Doppler navigators which they were showing. There were two, the AD.2300 developed in the U.K., and the CMA-621 developed by the Canadian firm. Both are continuous-wave frequency modulated radars and both were shown with associated computer devices to process the basic Doppler groundspeed and drift information into more readily assimilable navigation form for the flight-deck. The Doppler navigation art being a young one in the civil airline business, there is no settled agreement yet on what a computer may do. A number of the bigger carriers have been carrying out equipment and system trials in the last year or more to establish their real needs and those of the A.T.C. environment in which they fly. Marconi are therefore offering two main types of computer each in its way complete, but each based on slightly different operational philosophies. Both computers provide for feed-out to the flight indicator system or autopilot, and it was an interesting development in itself and a sidelight on present day tendencies that an optional pictorial (chart type) display is offered. The one shown was built by **Kelvin Hughes.** The AD.2300 has already done hundreds of hours flight assessment in one of B.O.A.C.'s Britannia 102s ranging over the whole of their Far Eastern and African route system with very fine results and it is understood that it will now go into some of their Comet 4 aircraft for the final stage of evaluation.

The Canadian set has an interesting feature which is believed to have been shown to be a desirable and useful refinement following the T.C.A. and PanAm flight trials with it. Basic to the design of the CMA-621 there is a land/sea switch to deal with the

The Decca Navigator Flight Log computer, Type 930, engineered for enclosure in a half ATR case





Decca Navigator Mk 10 receiver engineered to Arinc form factors. The two side chassis hinge outwards for servicing

reduction in accuracy which can take place over certain sea states. A third setting has now been incorporated so that over smooth water the radar is converted from the conventional Janus four-beam system to a two-beam radiation, port and starboard of track, the aerial at the same time being given a fixed forward pitch to increase the energy in the radar loop. The C.M.C. Doppler is exhibited in association with their comprehensive computer type CMA-601. This is a transistorized unit and uses digital displays.

As their contribution to Autoland, **Murphy Radio** had on show the leader cable element of the B.L.E.U. automatic landing system. The purpose of the Murphy development is to provide the magnetic signals for the guidance and control of the final stage of the approach and landing rôle. It consisted of the ground generation and monitoring equipment and the airborne aerial and receiver units and control box.

A wide range of air surveillance and special purpose ground radars were brought to the exhibition by **Decca Radar.** The company's work on anti-precipitation techniques on their 10 cm scanning radars, which has been a feature of their earlier Shows, has undergone still further refinement and was demonstrated this year in their DASR.1 surveillance radar. This radar has undergone extensive operational proving at an airfield in this country and it is understood that the new and more precise circular polarization techniques which it embodies have reduced rain clutter to negligible levels. Perhaps the most impressive of this battery of radars was a 10 cm height-finding radar, the Decca HF.200, which also employs the company's circular polarization system to combat rain returns. The very large aerial structure was demonstrated performing to complex height-finding motion under the control of a simulator. In operational use, the HF.200 would move in response to controls from a plan radar azication display in order to give heights of selected targets. Decca claims high accuracy of measurement for this radar and it has several interesting operational features. Both slewing and nodding motions are governed by a hydraulic system giving linear vertical sweep, an ability to nod whilst slewing and a high information rate with smooth positive control. A means is provided for automatically limiting the excursion of the nod when the target is at long-range. This is done to avoid useless scanning in the higher elevation angles.

Another of the Decca radars which has seen substantial development since it was introduced three years ago is the 3 cm wind-finding radar, which was shown this year in its Mk 2 form. Increased performance has put up the slant range capability of the radar and the antenna can now be switched to broad-beam radiation in addition to the precise narrow-beam normal condition, to simplify the tracking of a target at the start of an ascent in high wind conditions. Another important addition is the facility to stop all the dials at the moment at which readings are required so that these can be read at leisure, and then automatically restored to the new position of the aerial. This radar and its Mk 1 predecessor has been adopted by twenty meteorological authorities throughout the world.

Although civil aircraft communications are not yet in the U.H.F. aeronautical band, another fine example of contemporary engineering was shown amongst the exhibits of the Plessey Company in the ARC-52 U.H.F. airborne transmitter/receiver equipment. This is a radiophone set having 1,750 channels and is in use by the R.A.F. and the Navy and by NATO air units. This was shown with its special test set which is so designed as to permit a fault-finding routine of the "tiered" kind.

The Comet 4 passenger cabin address was shown by **Trix Electrical.** This is a completely transistorized equipment and in the modern trend displaces the large central amplifier in favour of local amplifier units at the speakers. The speakers are of the column type and a music input is provided. The installation in

The Marconi AD.308 transistorized H.F. receiver and flush aerial with Creed airborne teleprinter for airline use

Round the Stands . . .

the Comet is known to perform very well in practice and has cleared up many of the troubles associated with the not easy business of making the cabin staff heard in an aeroplane interior.

The **Redifon** stand had a new transmitter to engage the attention of communications people responsible for providing the telegraph and telephone facilities of the aeronautical radio services. The new G.420 family is a 1.5 kW peak-power transmitter covering the band 1.5-30 Mc/s and providing for various transmission modes and modulation types. It permits single-sideband and independent sideband working, gives facilities for pre-set on up to eight frequencies and several drive units are available, e.g. for twinplex telegraph working, facsimile transmission, frequency-shift keying and radio-phone. It is designed in unit form to satisfy the diverse needs of the individual user and permits him to add or change as the needs of his service dictate.

Both Fleet Air Arm and R.A.F. are now well into their conversion from V.H.F. to U.H.F. communications radio. **McMichael Radio** produce the blade aerial, suitable for supersonic flight, and seen on many aircraft in the display. **W.S. Electronics** showed the D.120 U.H.F. transmitter/receiver which solves the twin problems of correct frequency correction and peak-performance tuning.

The noticeable revival in radio for light aircraft brought the **Plessey** PTR.161 lightweight, six-channel V.H.F. remote control radio and the Amalgamated Wireless (Australasia) Airmite 2 four-channel set with self-contained power supply and total weight of 14 lb. **Burndept** showed the new five-channel light aircraft 1W V.H.F. radio which includes a transistorized power supply for 6, 12 or 24V supplies. It has been designed for 50 kc/s channel-spacing but is produced with 100 kc/s spacing. It weighs 6½ lb. It costs about £90 and crystals can be changed in flight.

Navigation Equipment

The British industry is now fast catching up with the formidable American technological lead in inertial navigation equipment and systems. Last week *Flight* recorded the opening of **Ferranti's** new inertial gyro-production laboratory in which both Kearfott and Ferranti units are to be produced. The **English Electric Instrument Wing** exhibited at Farnborough, for the first time anywhere in the world, a working example of the Minneapolis Honeywell miniature stable platform incorporating the GG.49 miniature integrating gyros which the Wing is now producing under licence at Stevenage together with the pendulous current-balance accelerometer GG.56. These items are suitable for the so-called short-term inertial navigators in which various gyros could be combined. One might be two GG.49s stabilizing a larger azimuth gyro. Also on the stand was a simple Polar-axis test table to which an electronic chart recorder was coupled for general testing of mechanical characteristics of gyros. The Kearfott rate integrating floated gyro costs several thousand pounds and the American price of an M-H GG.49D miniature floated gyro is about $6,000. **Sperry** were exhibiting the Rotorace gyro, both in the C.11 compass system and the twin gyro fully manœuvrable platform. Costing about £1,000, the Rotorace has a specified random drift of 1 deg/hr and actually achieves ½ deg/hr. Inertial tolerances are, of course, much closer.

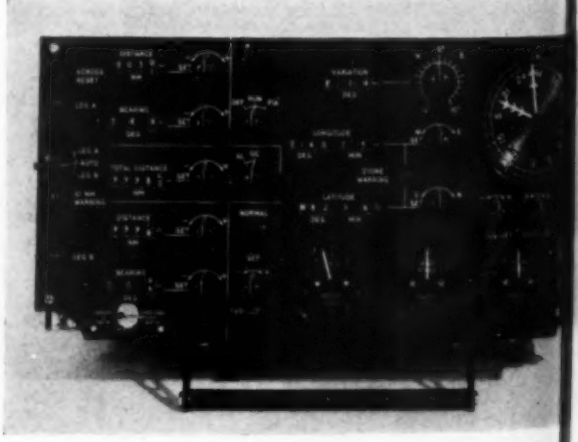
Elliott Bros. are producing the inertial guidance for the Avro stand-off bomb, but were only able to show a general illustration of the "mission profile" of this weapon. **Graseby Instruments** were exhibiting their Polar-axis test table for inertial gyros and also the G.I.390 Universal Gyro Tester in which a complete range of tests can be carried out without shifting or switching off the gyro. The mounting for the gyro itself was of a size appropriate to the Kearfott floated gyro. The Universal Gyro Tester can be used, without stopping or re-mounting the gyro, as a three-axis precision dividing head for closed-loop tests or, alternatively, by using the servo control of the gimbal it can be used to study the performance of the gyro while the latter is actually stabilizing a platform. During either test all three axes have 360 deg freedom of movement. A reading microscope and a photo-electric readout device are incorporated and, with a suitable timer, performance figures can be recorded directly on an electric typewriter to allow unattended testing over a period of hours.

Having achieved the technological capability to produce the extremely precise equipment needed for inertial systems, British companies are now undertaking the design of complete navigation systems and it is noteworthy that they are confident that the gyros they produce will be every bit as good, if not better, than their American equivalents. Having finally tackled this exceptionally difficult task, British manufacturers seem quite confident of being able to carry on successfully on their own initiative.

Special-purpose navigation computers are being produced for a variety of military applications. Already well known are the automatic plotting table produced by **Louis Newmark** and the automatic map plotter by **Kelvin Hughes.** Exhibited this year was the Sperry Radio Track Guide coupler system for automatic track-following using radio aids such as Decca, Dectra, Vortac, Gee and Loran C. Appropriate co-ordinates of departure and destination points can be set manually or by punched card and the device will then compute a virtually straight course between the two and provide heading error signals to an autopilot. Trials with coupling to Decca have been carried out and both military and civil applications are foreseen. The only new equipment required is the computer which weighs 50 lb and has a volume of 1 cu ft. In future it would be possible to control aircraft automatically in both time and space, thus making full use of the airspace available for civil operations. In this instance a computer on the ground would be needed to produce route programmes and to check flight clearances. The information could then be used to check progress of aircraft during flight.

Another relatively new navigation computer is the **Canadian Applied Research** Anadac. It incorporates a pictorial map display and control panels together with course and distance dial and wind velocity dial. Switches provide for operation as a plain D.R. computer or coupling with A.D.F., Tacan or Doppler. A further control allows the selection of automatic course and distance presentation to any one of five pre-set bases selected by push-button.

One of the computers offered for use with the Marconi AD.2300 Doppler radar



Straight and Level

ARE aeronautical products sold by aeroplanes performing circus antics in front of a crowd? Is "thrilling" the keynote of the S.B.A.C. Display, instead of "selling"?

Like myself, you may have asked yourself these questions—perhaps while watching the flying display, some parts of which are now performed very close to the limiting ceilings of human skill and courage.

Though justifications are sometimes *ipso facto* indictments, I will try to put some of my thoughts on these questions into words.

It seems to me that any national industry which hopes to succeed in a competitive world must think and act big and collectively, on a grand scale. The expression of this imperative is the annual display at Farnborough. Like the Motor Show or the Radio Show, the S.B.A.C.'s trade exhibition could just as easily be held at Earls Court or Olympia in London. Instead, the industry chooses to wrap its goods in an alluring flying display.

For no particular reason we picked Morfax as one of those exhibitors who make utterly unglamorous things—ground support gear like engine servicing stands and platforms — and asked the man on the stand whether he thought the show was worthwhile. "We couldn't afford not to be here," he said. The contacts he had made with potential customers were, he said, invaluable.

I think it reasonable to suggest that those pretty box formations in the flying display are the pretty boxes which motivate buying—particularly in the ancillary and equipment sections of the industry. This is a point that I think is missed by the cynics who say that circus antics do not sell aviation products.

● Talking about sales-motivation at the S.B.A.C. Display, my *Flight* colleagues noticed that this year more firms (perhaps influenced by the Paris Show) had pretty women on their stands.

I report without comment the experience of one staff-member who was compelled by a particular attraction (as well as, of course, by the technical merit of the associated exhibits) to visit a certain stand in the outdoor exhibition.

He joined the queue, and when his turn came he inquired about the missile-like display in the centre of the stand. "Oh, that," she said, "that's just a display made out of the different materials we make and shape. We always like to have something eye-catching on our stand, you know, and this is it."

● A couple of people have mentioned to me the difficulty they found at Farnborough in getting hold of the right people on the bigger firms' stands. "Well, you see, I'm in the so-and-so division, and I wouldn't know, but I'll see if there is anyone here who might know."

This sort of thing is not easily avoidable as firms grow larger. And it is particularly difficult where mergers are concerned, when the dichotomy of individual responsibility becomes manifest in almost every department of the outfits concerned, from top management downwards. I mention this because answers like: "Well, I'm not really the right chap" are symbolic of industry's biggest human problem today —co-operation to achieve the most efficient combination of resources.

This is Margaret Jeffery of B.O.A.C., and she is trying out a new set of plastic ear plugs issued by the Corporation to its staff who are exposed to jet noise. The plugs, superfluously explains the caption to the news-agency picture, are designed to "fit into the ear"

● A film shown on the de Havilland stand at Farnborough provided, quite incidentally, a remarkable illustration of the capabilities of an erstwhile competitor, the Gloster Javelin.

The film showed a D.H. Firestreak, air-launched from a Javelin, doing a smart demolition job on a Jindivik pilotless target. The Javelin had taken off from Llanbedr in Wales, the Jindivik from Woomera, Australia.

● Another staff-member was closely scrutinizing the Fairey Gannet AEW.3 when a Fairey service engineer in the cockpit—obviously not recognizing my colleague as one of *Flight's* team of experts—said (just loud enough): "I like this new device for detecting when you're flying under water."

● The formation-flying rivalry between the R.A.F.'s Treble One Squadron of Hunters and the Royal Navy's 807 Squadron of Scimitars has become quite legendary. I hesitate to pass judgment; but the consensus of opinion in *Flight* seems to be that the performance of the R.A.F.'s *commentator* at Farnborough was superior to that of his R.N. opposite number. The Silent Service's commentator was, we thought, just a tiny bit whizzo.

His opening remark on the Monday, introducing the Scimitars at the end of the year's most splendid air display, was: "And now ladies and gentlemen, the show you've all been waiting for. . . ."

● Enough of the S.B.A.C. Display for the moment. I would like to turn to something said recently by that eloquent prince of air transport, Sir William Hildred, director-general of the International Air Transport Association. Forget, again for the moment, about all those unsavoury allegations of price-fixing that he has to answer for, and consider this:—

"I will not go so far as to say that I.A.T.A. represents a small successful working model of a democratic process on a world-wide basis, although in my opinion it comes close to that. But I do believe that the statement in Chapter 1 of the Chicago Convention that 'every State has complete and exclusive sovereignty over the air space above its territory' is a doctrine which must give concern to the Almighty. National sovereignty undiluted by the rule of law becomes ever more dangerous. . . .

"If the aim of science is to do honour to the human spirit, we have in the aeroplane, that complex of technological excellences, one of the finest instruments ever made by man for his own well being and happiness."

● So B.O.A.C.'s Boeing 707 captains want £6,000 a year, £2,000 more than for flying Comet 4s. And no doubt B.E.A.'s Viscount skippers will want more for flying Comet 4Bs, and perhaps more again for flying D.H.121s.

Are increases sought because airliners are becoming more difficult to fly? If so, passengers must not get to hear of such arguments. Rather, perhaps, increases are sought because the pilots want a share of the higher productivity of the new aircraft.

Thus Britain's future supersonic airliner commanders can be expected to ask for £25,000 a year, which I hope is being taken into account in B.O.A.C.'s estimates of supersonic airliner operating costs.

● At the Dutch airfield at Volkel trials are being made with a new device to drive away birds, which can be a real nuisance, if not hazard, to aircraft. A loudspeaker, ten minutes before take-off, emits tape-recordings of the danger-cries of various species of bird. This noise, it is said, makes all the birds fly away. I only hope they don't fly into aircraft waiting to land.

ROGER BACON

Missiles and Spaceflight

Space Congress Ends

AMONG the most important obvious results of the tenth congress of the International Astronautical Federation, which ended in London on September 5, were the proposals for an academy of astronautics under Dr. Theodore von Karman (reported last week); for an international institute of space law; and for a permanent headquarters for the Federation itself. Less apparent except to the 650 delegates, but equally important, was the international interchange of experience and ideas which such a meeting makes possible.

Among the delegates from overseas there was strong U.S. participation—from government agencies, research establishments and private companies, all of whom have space and its applications as their daily business. By contrast, British representation was for the most part confined to the enthusiasts of the British Interplanetary Society, and members of a few companies wishing to get into the space act: officials of the Ministry of Supply, for example, seemed conspicuous by their absence and, by implication, indifferent to the arguments for space research which had been put forward by their own Minister on the opening day of the congress.

After a day spent away from the lecture hall, on an excursion to Windsor and a river trip on the Thames, delegates returned on Friday, September 4, to further technical sessions at Church House and also to a simultaneous colloquium on space law held at Lincoln's Inn (this colloquium is reported on the opposite page). Final papers were read on the Saturday, and it was at a morning business session of the Federation on this day that Prof. K. Zarankiewicz collapsed and died while acting as chairman. Prof. Zarankiewicz was a member of the Committee for Astronautical Studies of the Polish Academy of Sciences, and was a well-known author of technical papers.

The new president elected by the Federation is Prof. L. Sedov of the Soviet Union. Vice-presidents comprise Åke Hjertstrand (Sweden), Col. John Stapp (U.S.A.), Dr. Eugen Sänger (Austria), Gen. J. P. Bergeron (France) and Dr. L. R. Shepherd (Britain). The proposal that the Federation should study plans for the establishment of a permanent headquarters was made by Mr. Hjertstrand and was adopted unanimously; Paris is believed to be the probable location. Next year's I.A.F. congress will be held in Stockholm.

At a congress dinner at the Dorchester Hotel on Saturday evening, September 5, a tribute to "the growing stature" of the Federation was paid in a speech by Dr. Hugh Dryden, the deputy administrator of the U.S. National Aeronautics and Space Administration. Mr. Andrew Haley, the I.A.F. president, recalled the formation of the Federation ten years ago and, emphasizing the essential internationalism of the movement, said that the freedom of cosmic space must be the main objective. The deep regret of all delegates at the untimely death of Prof. Zarankiewicz was voiced by Mr. Haley.

Other speeches at the dinner were made by Dr. Shepherd, B.I.S. chairman, who also stressed that the development of spaceflight must be an international affair; and by Mr. Hjertstrand, past chairman of the Swedish Interplanetary Society, who assured everyone of a hearty welcome at Stockholm in 1960.

Ten of the papers presented at the congress were summarized in last week's issue, and further abstracts are given on this page, preceding the report of the space law colloquium.

Determination of Air Density and the Earth's Gravitational Field from the Orbits of Artificial Satellites, *by D. G. King-Hele of the Royal Aircraft Establishment, Farnborough:* This paper presents methods for evaluating air density, scale height and average wind speed in the upper atmosphere from changes in the orbits of artificial satellites. The oblateness of the Earth and atmosphere, tumbling of the satellites and the rotation of the atmosphere are all taken into account.

The methods are applied to the ten satellites launched in 1957 and 1958 whose orbits are known in order to determine average air density at heights between 200 and 400 km. The results indicate that density decreases from 4.3×10^{-13} gm/c.c. at 200 km to 7.1×10^{-15} gm/c.c. at 400 km. Variations in air density are also determined, and these reveal maximum values at remarkably regular intervals of 28 days, implying an association with solar effects.

Scale height and air temperature cannot be determined with as great an accuracy as density, but the average scale height between 200 and 400 km is probably about 50 km and the average temperature about 1,000 deg K. Observed changes in the orbital inclination of Sputniks 2 and 3 suggest that the average wind at heights of 200-400 km is from west to east.

Determination of Atmospheric Density at an Altitude of 430 km by the Sodium Vapour Diffusion Method, *by I. S. Shklovsky and V. G. Kurt (U.S.S.R.):* In order to confirm the recent air density observations derived from the braking of Soviet and American satellites in the altitude range of 270-750 km, the analysis of the diffusion of sodium vapour emitted from rockets is proposed. This method was originally suggested by Bates and several American experiments were made at comparatively low altitudes (75-140 km).

The first experiment of this type in the upper atmosphere was made on September 19, 1958. When the Soviet rocket reached 430 km at the height of its trajectory the programmed ignition of thermite caused the ejection of sodium vapour from two vaporizers containing 2 kg of metallic sodium each. The sodium vapour cloud, lit by the rays of the sun above the earth shadow, was photographed and the photographs were analysed by the standard astrophysical method. The atmospheric temperature was estimated as more than 1,600 deg K from the accepted basic constituent—atomic oxygen.

The density figures obtained by this method, which can be used up to 500-600 km, were compared with the data from satellite braking and are shown to be between 10^{-14} and 10^{-15} gm/c.c. at 430 km altitude.

Multi-Directional g-Protection during Experimental Sled Runs, *by Harald J. von Beckh (Aeromedical Field Laboratory, Air Force Missile Development Center, Holloman Air Force Base):* The author described at the eighth I.A.F. Congress a device termed "Anti-g Capsule" which would protect a human operator or a test animal against high g-loads during space and atmospheric flight. This capsule is pivoted about the lateral axis of the craft and automatically assumes a position such that the resultant of all acting accelerations is perpendicular to the heart-head line of the subject. The ejection and stabilization mechanism of this capsule would also afford an analogous g-protection during and after escape from a disabled space vehicle within the lower layers of the atmosphere.

For testing this g-protection principle an "Anti-g-platform" was designed and mounted on catapult-driven and rocket-driven sleds. This platform consists of an aluminium sheet in the form of an isoceles triangle. Its basis is adapted to tie down a rat measuring up to 7.5in. This triangular platform was pivoted on its apex by a vertical axis which was fixed on the structure of the sled, and allowed free rotation.

Before the firing, an albino rat was tied down parallel to the base of the platform and brought in a head-forward position. The control animal was tied down in a non-movable wire netting cage in an identical head-forward position. The g-loads of the acceleration act, therefore, on the unprotected control animal in head-tail direction and those of the decelerative phase in tail-head direction. The anti-g platform, however, swings back with the onset of the acceleration. In this way the animal avoids the longitudinal g-load and receives the rest of the load in a direction transverse to spine.

On the other hand, it could be shown that during re-entry the decelerations in the longitudinal direction of the operator would be minimized. The position of the capsule at the beginning of deceleration has little influence on the protective effect.

Recent Developments and Designs of the Ion Rocket Engine, *by R. H. Boden (Rocketdyne Division of North American Aviation):* Recent developments of ion rocket engines have proceeded rapidly in the last two years under research programmes sponsored by the Air Force Office of Scientific Research. In order to understand the trend of this progress a brief summary of the basic relationships governing the operation of electrical propulsion systems are summarized.

The cross-sectional area of the engine is estimated by considering a flat-plate electrode configuration and the modifications imposed on this idealized situation by the presence of an aperture through which ions are emitted.

The relationship of engine design, vehicle design, and the mission results from the characteristic velocity required to accomplish the objective. Methods of mission analysis are referenced, but not discussed in detail. These methods result in characteristic velocity requirements which in turn establish the specific impulse or exhaust velocity the engine must develop.

The specific impulse cannot be arbitrarily chosen if the maximum payload is to be transported in the vehicle. The variation of the payload with specific impulse is demonstrated with some typical examples. The overall variation depends upon the weight of the vehicle per unit power developed and the efficiency of conversion of primary energy into directed kinetic energy in the exhaust jet. The analytical relationship among the characteristic velocity, weight per unit power of the vehicle, efficiency and the specific impulse to obtain maximum payload is graphically presented. The maximum payload for a mission accomplished with an electrically powered vehicle is estimated from these data.

The characteristic velocity of the mission also determines the operating time of the electrical rocket engine. In general it is desirable to use as low a specific impulse powerplant as possible in order to reduce the operating time; however, the operating time is also dependent upon the thrust-to-weight ratio of the vehicle. This ratio depends on the capability of the vehicle to generate adequate amounts of power. The limiting thrust-to-weight ratio has been summarized graphically for several types of vehicles including ion, plasma, and chemical rockets and modern aircraft. Comparative maximum payloads of chemical and ion rockets are presented in terms of the mission characteristic velocity.

The experimental programme and techniques for verifying these analyses on a specific type of ion rocket engine conceived at Rocketdyne are presented. The experiments are conducted in high-vacuum environments. The ion thrust chamber discussed in this paper uses electrostatic acceleration of ions generated from surface contact ion sources. Preliminary evaluation of the results of the programme indicate that a flyable prototype engine can be produced within a few years under the impetus of a progressive development programme.

NO EARTHLY USE?

THIS report of the second Space Law Colloquium held at the New Hall, Lincoln's Inn, on September 4 (under the auspices of the tenth congress of the International Astronautical Federation), is divided into four main sections: (1) What is a colloquium? (2) procedure; (3) points from some of the papers; and (4) a preliminary appraisal.

WHAT is a Colloquium? A venerable law dictionary gives one meaning of the word: "A talking together: a conversation." Such conversation or talking together as did take place in the New Hall did not take place from the platform as an interchange of views between speakers and audience. This was a great disappointment and destroyed the value of the occasion for those who were unable to meet participants at the various social functions which were arranged.

At the outset the chairman of the meeting (Mr. C. N. Shawcross, Q.C.) invited delegates to submit any un-notified papers for incorporation in the proceedings of the colloquium. Thus the total input is not yet known. Other papers were handed in but are not so far generally available, and therefore no more than a preliminary assessment can be made of one day's goings-on. This was not a true colloquium but more like a written symposium, enlivened by authors who read their papers.

Procedure. It is to the credit of the organizers that, without counting addresses from the chair, twenty speakers were able to address the meeting in a very brief day's business in which both the morning and the afternoon sessions started late. The morning was opened by I.A.F. president Haley who introduced and handed over to chairman Shawcross and co-chairman Prof. J. C. Cooper.

The chairman opened by reading a message of goodwill from President Eisenhower and announced the attendance of a U.S. Congressional delegation—one of whose members, Congressman V. L. Anfuso, opened with his paper *Is Space the Way to Peace and Abundance?* Mr. Shawcross promised that he would submit a written paper himself in due course, and suggested that basic definitions might be tackled first and that all lawyers concerned with these problems should be armed with some understanding of technical matters.

Co-chairman Cooper spoke with the brief and dignified modesty which befits a life-long scholar. He had come, he said, rather to listen than to contribute and he paid tribute to the English Inns of Court as the home of a respected system of law. He paused only to define law as rules of human conduct—a definition which could well have been repeated by each succeeding speaker.

President Haley then spoke informally of the human and organizational difficulties he encountered when trying to deal at an international level with some technical problems of the first importance—the allocation of radio frequencies for use in space exploration.

Next came Dr. Welf Heinrich, Prince of Hanover, who reaffirmed his viewpoints of the previous year in a succinct paper *Circle of Thoughts*. Dr. Heinrich is rightly famous as the first known person to have submitted a doctoral thesis on space-law. It became evident that the "colloquium" was about to discard the possibilities of discussion when, in response to an inquiry from the floor, the chairman accepted the question but ruled that it could not be answered unless there was time available at the end of the day. The chairman then invited written questions for considered replies, but his invitation was not taken up throughout the day.

Other members of the presiding panel who spoke in the morning session included:—

Prof. D. Goedhuis (Holland), who noted that the idea was gaining ground that outer space was a *res communis* or *res extra commercium*—incapable of appropriation by any nation.

Dr. H. Safavi (Persia), who thought of the vertical limit of sovereignty as a nation's "front door."

Dr. M. Smirnoff (Yugoslavia), who thought that the situation was comparable to the failure of the 1910 Paris Convention, when a private group of lawyers had to work out solutions to prepare for the 1919 Convention which survived till 1944. He had gone so far as to draft a 14-article convention himself which included *inter alia* no national sovereignty in outer space; control by an international organization and a restriction of the usage of space to peaceful purposes.

The afternoon session got off to a flying start by the passing of two surprise resolutions which effectively dissolved the 150-man Permanent Legal Committee of the I.A.F. and substituted an unnamed "international institute of space law" together with a startled *ad hoc* committee of six. The theme of the afternoon was undoubtedly "Let's get on with the job!" Possibly it is only of concern to the I.A.F. that these resolutions and elections took place in an atmosphere more reminiscent of a comic opera than a session of lawyers.

The *ad hoc* committee's purpose is "to draft bye-laws for the organization and government of the institute which will be in accordance with the constitution of the I.A.F. and subject to the approval of the council of the I.A.F." The committee is composed of Mr. Shawcross (chairman), Mr. Haley (secretary), Dr. Smirnoff (Yugoslavia), Dr. Gerlach (Germany), Prof. Cooper and M. Homburg (France).

One more sensation completed the day's procedural excitement. The seventh speaker in the afternoon session was Dr. I. H. Ph. de Rode-Verschoor (Holland) on *The Influence of Outer Space Exploration on Mankind.* This was a paper on the scheduled list and pre-prints were available, but when Dr. Rode-Verschoor was drawing near the end of her remarks the chairman ruled that political questions should not be discussed and asked her to terminate her address with that in mind.

The proceedings were drawn to a close by the chairman who regretted that he had been unable to welcome the colloquium on behalf of the Masters of the Bench of Lincoln's Inn because he was not of that Honourable Society, but he called upon Prof. Cooper for a formal vote of thanks. Mr. Shawcross complimented two speakers on the importance of their contributions—Mr. G. J. Feldman who, in a non-scheduled paper, gave a provisional appraisal of the Report of the United Nations Legal Committee on the Peaceful Uses of Outer Space; and Mr. K. A. Finch, an outstanding young American lawyer who had gallantly given precedence in the scheduled proceedings to Mrs. Galloway's excellent contribution (see below) and in consequence was only able to summarize one of the points from his longer paper.

Mr. Shawcross emphasized what a massive work programme lay ahead—"So little time, so much to do"—and Prof. Cooper concluded by expressing his envy of the scope available to younger men and hoped that they would find outer space a peaceful medium in which to work.

Points from Some of the Papers

Is Space the Way to Peace and Abundance? by V. L. Anfuso of the Science and Astronautics Committee of the U.S. House of Representatives.

There are grave dangers in the deceptions of international diplomacy. The untold possibilities for peace and prosperity which are inherent in the exploration of space should be fruitful areas of international co-operation. Within United Nations there should be a Committee on Space Co-operation with *fair* representation from East and West.

The Future of National Sovereignty, by S. M. Beresford, Special Counsel, Committee on Astronautics and Space Exploration, U.S. Congress.

There are too many difficulties at present in defining a vertical limit to the extent of sovereignty—moreover such a limit is inadequate on the defence purposes. It is far better to seek international agreement on the control of specific activities in space and by this means evolve a series of legal rules.

Toward Solving the Space Sovereignty Problem, by H. T. P. Binet, Honorary Secretary, Astronautical Society of Canada.

Despite the difficulties admitted by ICAO and the fact that the U.S.S.R. is not a member, ICAO still appears to be the best agency for administering space rules—if sovereign states can agree that all that is needed is a series of rules prescribing the use of space *including air space*. Thus the need for marking any boundary between air space and outer space would disappear.

Territorial Claims to Celestial Bodies, by K. A. Finch, Federal Communications Commission, Washington.

Although the U.N. *ad hoc* committee regards the problem of exploration of celestial bodies as a low-priority task, recent information released from the U.S.S.R. suggests that their moon-probe will contain *inter alia* elements to represent a Russian flag for the obvious purpose of release on to the lunar surface. This further suggests that the U.S.S.R. may be preparing to assert sovereignty by means traditional in international law and the problem of international agreement on this topic is therefore of the utmost urgency.

Dynamic Limitation of the Freedom of Cosmic Space (in French), by E. Fonseca, Director, Centro de Estudos Astronauticos, Lisbon.

Regions of control may be prescribed which will depend on whether the gravitational pull of the Earth or of a particular planet is the predominant effect. So, for example, there would be a right of free passage for vehicles capable of escape velocity from a given planet, and a different regime for those only capable of orbiting. Vehicles incapable of orbiting would fall into the traditional realm of air law.

The United Nations Ad Hoc Committee on the Peaceful Uses of Outer Space: Accomplishments and Implications for Legal Problems, by Mrs. E. Galloway, Special Consultant, Committee on Aeronautical and Space Sciences, U.S. Senate.

In this excellent summary Mrs. Galloway describes and analyses the report which the U.N. *ad hoc* committee will present to the General Assembly of U.N. The Legal Committee, which was charged with "The nature of legal problems which may arise in the carrying out of programmes to explore outer space," came to the broad conclusion that premature codification of space law might hinder rather than help progress, and the IGY example of international co-operation may be a useful precedent indicating the consent of nations to future exploration programmes if based on a similar degree of international agreement. At least five priority problems were identified:—

1. Liability for injury or damage caused by space vehicles.
2. The allocation of radio frequencies to space vehicles.
3. Avoidance of interference between space vehicles and aircraft.
4. Identification and registration of space vehicles and the co-ordination of launchings.

Missiles and Spaceflight . . .

5. Permission of subjacent states for re-entry and landing of space vehicles in the airspace.

The legal committee also expressed the view that celestial bodies ought not to be subject to the sovereign claims of any nation, but used solely for the benefit of mankind under an international administration. Unfortunately, the U.S.S.R., Czechoslovakia, Poland, the United Arab Republic and India declined to participate in the Committee's work.

Space Exploration—The Problems of Today, Tomorrow and in the Future, by A. G. Haley, President, I.A.F.

The jurisdictional boundaries between air law and space law should correspond to the transition between aerodynamic flight and ballistic orbiting—the so-called Karman line. The I.A.F. has been able to co-operate actively with the International Telecommunication Union, in particular its Radio Consultative Committee on the important problem of allocation of adequate radio frequencies for space vehicles.

The Law of Space and International Conventions (in French), by R. Homburg, President of the Legal Committee of the French Astronautical Society.

Although there are no clear limits between air law and space law it is clear that space exploration will first require rules for extra-terrestrial navigation and there is no reason why relevant rules from existing conventions should not be applicable to space vehicles. For example, the Chicago Convention, so far as it relates to pilotless flight, health, registration and nationality; and the Conventions of Rome and of Warsaw relating to the liabilities of air carriers.

Air law would thus become one chapter in universal space law.

Some Rules Regulating Earth-to-Earth, Space-to-Earth, and Earth-to-Space Missiles and Interplanetary Vehicles, by R. A. Javitch, Honorary Treasurer of the Astronautical Society of Canada.

A first attempt is made to formulate some basic terminology which may be appropriate for such rules.

Summary of Legal Problems of Outer Space (U.S.A. and Soviet Viewpoints), by Dr. S. Kucherov, Library of Congress.

Soviet views on outer space have evolved from the narrow idea of an infinite extent of sovereignty to the idea that although outer space is beyond any national sovereignty, nevertheless many of the accepted rules of international law will still apply. For example, force should be excluded as a means of solving international disputes. On the other hand, the United States has not yet conceded that the United States may have no sovereign rights in outer space.

The existing differences in viewpoint between the two nations are essentially political and closely related to the problems of disarmament.

Some Discussed Questions Relating to Space Law, by Prof. Dr. A. Meyer, Air Law Institute, University of Cologne.

The legal status of unmanned space vehicles which land, intentionally or otherwise, in a foreign State is no different from that of any other object identifiable as belonging to a foreign State. Analogies of bullets or smuggled goods are not appropriate. The legal status of outer space will be an important problem until such time as its nature becomes clear from the form of international agreements governing its use.

Proposals for the Future Work of the Permanent Legal Committee of the I.A.F., by Dr. E. Pépin, Institute of Air and Space Law, McGill University.

Small working groups on selected topics are essential if the large, unwieldy committee is to achieve any useful results. This most practical viewpoint was translated into action by the afternoon session (see above).

World Space Law: Leading Principles for its Codification, by Prof. F. W. von Rauchhaupt, University of Heidelberg.

"World Space" begins around 300 km at the Karman line (see above in Haley's paper) and includes the planetary system which ought to be free and accessible to all nations. Space explorers ought not to harm any living thing and rules evolved in the 16th century by Spanish theologians may be useful. Some kind of "World Space Administrative Union" will ultimately be necessary.

How Shall Space Laws be Introduced? (in French), by Dr. J. Rivoire, France.

Notwithstanding the report of the U.N. *ad-hoc* committee, it will be necessary to create a Space Agency within the framework of U.N. In order to make a start on regulating space activities, any rules proposed must be at once simple and flexible. Law cannot be founded on empirical rules of a swiftly changing technology.

The Space Agency would be responsible for all space vehicles which either (a) rose more than 1,500 metres above sea level, or (b) orbit the Earth as satellites at any altitude. Possibly the only effective sanctions would be the withholding of scientific information.

Functional Regulation of Outer Space (in French), by M. S. Vazquez, College d'Italie, Cité Universitaire, Paris.

United Nations will be the proper agency to reach international agreement in three areas: (i) the vertical limit of air space, (ii) a contiguous zone reaching from this level up to 36,000 km (said to be the height at which a satellite can orbit at the same speed as the earth rotates) and (iii) outer space beyond this level in which all human activities would be regulated by U.N.

Space and Cognopolitics—a Third Force in World Affairs, by P. B. Yeager, Staff Consultant, Committee on Astronautics and Space Exploration, U.S. House of Representatives.

"Cognopolitics" is defined as politics based on knowledge (of science). As a word it may cause classicists to shudder, but it is used as a shorthand to describe the awareness of scientific achievement which characterizes top-level U.S. and U.S.S.R. diplomacy. The two traditional sources of power, physical force and economic force, may ultimately give way to a third force—international power based on scientific mastery.

The Report of the United Nations Legal Committee on the Peaceful Uses of Outer Space: A Provisional Appraisal, by G. J. Feldman, Director and Chief Counsel to the U.S. Committee on Astronautics and Space Exploration.

It is distressing that so little should have come out of such a great deal of deliberation. "Peaceful" should mean "non-aggressive" and not "non-military," otherwise there will be little left of a nation's inherent right to self-defence, specifically guaranteed by the United Nations' charter.

Preliminary Appraisal. Until the U.S.A. and the U.S.S.R. can agree on a set of rules to guide explorations beyond the earth, space law does not exist and is only one stage removed from space fiction. At this stage every man can be his own space lawyer.

Until the full number and text of the papers at the Second Space Law Colloquium are made known it will not be possible to assess results accurately. The I.A.F. undoubtedly acts as a focus to concentrate the thoughts of a great many lawyers on the legal problems of space. But the Federation has not yet drawn on all available sources. For example, out of 28 papers scheduled for delivery, only one was attributed to an English lawyer.

Until the newly organized I.A.F. institute for space law has a chance to work it will be impossible to gauge its possible value, particularly in reply to the recent U.S. Congressional criticism that the I.A.F. is "relatively loosely organized."

One thing is very clear: if the I.A.F. wish to organize another such session then they should either change the title or the organization and procedure of the meeting. A "colloquium" implies discussion, and there is still an aching void to be filled by useful non-political discussions between leading lawyers of the world on the way to the stars. Perhaps the Federation might consider a joint session with the International Law Association.

So far, the lawyers of the world have little or nothing to offer the scientists or the peoples of the world in their desire to explore space. If international politics will permit, it is more than likely that scientists will solve these problems for themselves along the lines of the International Geophysical Year organization.

So far as one can detect a trend from the papers released to date, there appears to be a growing realization that the vertical limit of sovereignty is not the most important problem. The way ahead lies in the evolution of simple rules for the conduct of space exploration which will not hinder scientific progress but will be consistent with a humanitarian Rule of Law.

H. AIREY.

Because of the exceptional importance of the International Astronautical Federation congress and space law colloquium, coupled with the S.B.A.C. Show at Farnborough, the regular items of news on Missiles and Spaceflight have been held over for one week.

Developed for NASA by Chance Vought Aircraft, a Scout research rocket is depicted here in the firing position 20 deg from the vertical on its 109ft launcher. A structural-test specimen, the vehicle shown has no fairing between the first and second stages and the tip has balsa baffles to prevent wind-induced vibration

FLIGHT-PLANNING MADE EASY

Bristol show how to get more out of the Britannia

IN an article in *Flight* for March 7, 1959 ("Vancouver-Return by C.P.A.L. Britannia"), reference was made to a new short-cut method of Britannia flight-planning developed by Bristol. "Packing several pounds avoirdupois of flight-manual into a single paragraph," we wrote, "it exemplifies an obedient answer to the classic Churchillian demand: 'Pray let me have, on one sheet of paper . . .'"

Bristol have now considerably refined this short-cut method. Though it runs to rather more than one sheet of paper it certainly appears to be a remarkably "miniaturized" version of the hefty manual so well known to overworked navigators.

Bristol have developed the new method largely as a result of co-operation with C.P.A.L., who in November 1958 approached the company with a flight-planning problem relating to their 5,000-mile trans-Pacific route between Vancouver and Tokyo—a route notorious for its powerful and capricious high altitude jetstreams. So capricious, indeed, that pre-take-off flight plans often become invalidated *en route*, requiring new flight plans to be made rapidly.

In essence, the new *Britannia Operating Guide* (as Bristol's ops. development branch have named it) is a series of graphs, as reproduced on this page, laid out on both sides of a sheet of quarto paper. It is backed up by a few pages of explanatory notes in the form of examples. In due course Bristol hope to present the method in slide-rule computer form.

Bristol do not claim that the new method achieves as absolutely precise a standard of accuracy as the full manual-method; what they do believe, however, is that by saving flight-planning time it will save the operator money. Calculations involving changed headwinds and headwind-gradients power required, altitude, T.A.S. and I.A.S. can literally be accomplished *en route* in less than half a minute compared with perhaps half an hour previously.

Flying time costs more—much more—than fuel. It costs perhaps £300 an hour to fly a Britannia, of which fuel accounts for about £70. A saving of as little as one per cent per annum in flying time can reduce operating costs by perhaps £10,000 a year in one aircraft alone. By using the new method operators could, it is claimed, save as much as 4 per cent per year in flying time—which with a fleet of, say, six Britannias could mean the saving of nearly a quarter of a million pounds. Which, as Bristol say, is a sum not to be sneezed at.

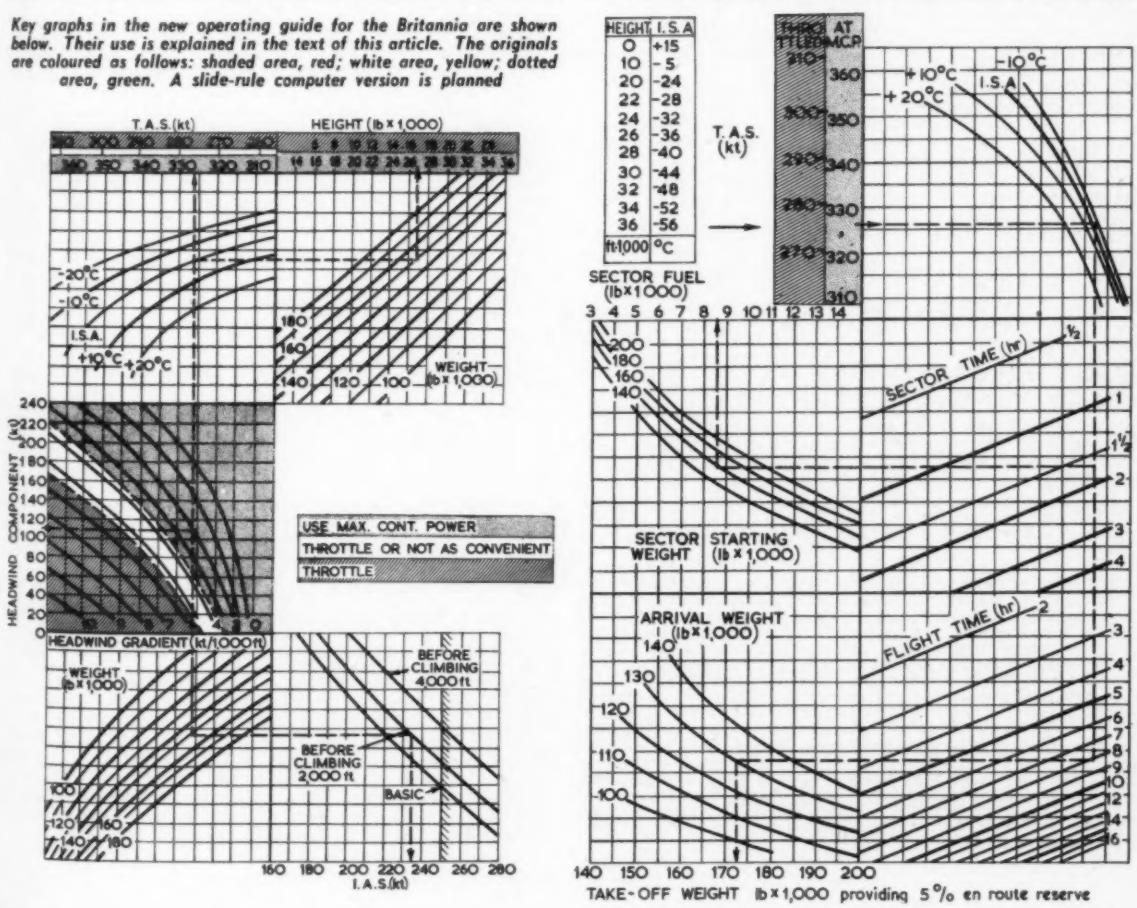
The old "one-sheet-of-paper" device, though refreshingly simple, had considerable limitations. For example, it did not take into account wind gradient—i.e., the variation of headwind component with height—a parameter of great significance in the planning of high altitude flights. Nor could you tell, just looking at the chart, at what height you were going to fly. It was not a flight-planning device in the true sense, merely an in-flight aid to the rapid re-working of a flight plan that had been prepared by the full manual method.

The new system is a flight-planning device in itself, as well as an aid to rapid in-flight planning.

The original graphs, which in the reproductions on this page are shaded, are in three colours. The areas thus denoted provide a quick guide as to whether throttling back below max. continuous power (11,650 r.p.m. on the Proteus 765) is necessary. There is, of course, a psychological resistance among crews to throttling back; it is hard to overcome the natural inclination of pilots to believe that throttling, by increasing specific fuel consumption, increases absolute fuel consumption. But in certain circumstances of wind gradient this is not always so, it being more advantageous from the T.A.S. point of view to drop height below the altitudes of high wind-gradient. Doppler equipment, incidentally, which can obtain true and instantaneous readings of wind gradient *en route*, is a valuable aid to in-flight planning on this score.

A few examples of the way the graphs are used are appropriate. To plan a long-range flight, when there is doubt as to whether the flight can be made non-stop or not, enter the headwind chart as shown by the arrow. If in the dotted portion, use max. continuous r.p.m. From this point determine T.A.S. by moving up to the dotted scale on the graph above. If the headwind gradient is such that you are in the shaded portion of the headwind graph, this means that you should plan to throttle, and T.A.S. should be read off the shaded scale. If in the white no-man's land between

Key graphs in the new operating guide for the Britannia are shown below. Their use is explained in the text of this article. The originals are coloured as follows: shaded area, red; white area, yellow; dotted area, green. A slide-rule computer version is planned



Among the Britannia operators making use of the new flight planning method are Cubana, who have four Britannia 318s in service

FLIGHT-PLANNING MADE EASY . . .

throttling and max. continuous power, this means that power will not affect the outcome of the flight and may be chosen to give the most convenient cruising height.

Cruising height is determined by stopping in the T.A.S. graph at the mean anticipated air temperature, and then running into the height graph on the right to read off, on the shaded or dotted scales as appropriate, cruising height. If the original entry into the headwind graph had terminated in the white area, height should be determined, generally speaking, as mid-way between the shaded and dotted heights (T.A.S. being reduced 5 kt for each thousand feet below dotted height, since wind is reducing by an average of 5 kt per thousand feet in the white area).

To determine flight time, subtract from T.A.S. the mean headwind component at mean cruising height, and divide this into track distance to give equivalent cruising time. Add 15 minutes to this to allow for climb and descent.

To ascertain arrival weight (i.e., weight 1,000ft over the destination, assuming that all reserves are intact except for *en route* fuel reserves) enter the second chart, as shown by the arrow, with T.A.S. and run through air temperature, flight time and arrival weight, finally reading off take-off weight.

This is the least take-off weight in which the flight can be made, allowing for a 5 per cent *en route* fuel reserve. If runway considerations permit a heavier take-off, either the flight can be made at a higher T.A.S., or more payload can be carried. In this case select a higher speed and go through the process again to find an appropriate take-off weight.

In many cases where "dog leg" tracks along airways make overall averaging of winds and temperatures unreliable, a sector-by-sector flight plan is required. (The word sector, in this context, means a segment of one particular flight, and does not imply that a landing is made.) In this case, the procedure described above should be run through for each sector, but instead of running down to the flight-time graph, turn off at the sector-time graph and into the sector-starting-weight graph to determine sector fuel.

For the first sector, starting from take-off, 1,500 lb should be added to sector fuel and ten minutes to sector time to allow for take-off and climb. For the last sector, 500 lb should be subtracted from sector fuel and five minutes from sector time to allow for the descent. These quantities do not vary much from one flight to another.

If you emerge from the chart with less than the "minimum sector fuel" (i.e., the minimum fuel required by operational requirements below which it is never permitted to go), then, of course, it is possible to use a higher speed. It is in this way that, by saving aircraft hours, complete extra flights can be squeezed in between checks, thus saving money.

The graphs at the bottom of the first chart, so far not referred to, are an in-flight guide to achieving the optimum flight that has been planned. In practice this amounts to deciding when to change from one to another of the cruising heights permitted by A.T.C. The example shown by the dotted line tells the captain that the best time to change, in one particular situation, is when the A.S.I. shows 230 knots.

Another use for this part of the chart is in planning the quickest possible flight regardless of fuel used, in accordance with the dictum that flying time costs more than fuel. Engine power is decided as before, and you enter with 250 kt I.A.S. (Britannia V_{no}, recently increased to 258), running up to the 2,000ft or 4,000ft lines depending upon the step-climbs required by A.T.C., or to the "basic" line if a drift-climb is permitted. Thence run across to approximate mean weight, then up to T.A.S. (shaded or dotted as appropriate), and also via air temperature and mean weight again to height.

The system makes it possible also to determine quickly, in cases where A.T.C. prohibit use of a particular height band, to go above or below this height. In other words, it is possible in a few seconds to see whether the aircraft is too heavy to attain the necessary height, and if so what amount of throttling is needed to fly below without exceeding V_{no}.

One possible limitation of the method is that it does not, in its present form, make allowance for three-engine cruising. However, range of the Britannia on three engines is claimed to be about the same as on four, and destination can still be made, though at a lower height, for the same I.A.S. In general, an engine failure would require a drift down of 7,000ft or 8,000ft.

The foregoing provides merely an outline of the method, which may well come to be used regularly by Britannia operators, in place of, or at least as an alternative to, the full "steam" manual method. It is indeed already used by C.P.A.L., Cubana and Hunting-Clan, and R.A.F. Transport Command are said to be most interested. Furthermore, the principle of the method may well be adapted to other turbine aircraft; and Bristol will have made an important contribution not only to the operation of their own product, but to the art of flight-planning in general in the turbine age.

J. M. R.

FOUR NATIONS, THREE JETS

WITHOUT doubt one of the most significant events of recent times in the field of air transport was the equipment agreement in October 1958 between S.A.S. and Swissair. Although the terms of this agreement between the carriers of four sovereign nations have been recorded and commented on in *Flight* on a number of occasions, it is of particular interest to note the following abridged extract from Swissair's annual report for 1958:—

"During the course of the year under review it became ever more apparent that the three DC-8s we had ordered would not be adequate to put us in a sufficiently competitive position in the period beginning 1960.

"We made a long and thorough investigation to find the best possible solution for our company. Right from the start we were forced to take account of the characteristics of our route structure which consists of long, medium, and short segments, with traffic, in some cases, varying greatly. Considered from this standpoint, there was no doubt that a fleet made up of three types of turbo-powered aircraft—with varying range—would be the best solution, and that, in the interest of our gaining the best possible competitive position, they should all be pure jet. On the other hand, considerations of operational economy pointed equally clearly to the advantage of restricting ourselves to two types of aircraft.

"It so happened that our friends in S.A.S., whose network, like ours, consists of long, medium, and short segments, were faced with similar problems. As both companies have thus far followed practically the same policy in the purchase of new equipment, they both own highly similar fleets of propeller-powered aircraft. Both have also ordered Douglas DC-8s. Moreover both companies agree to a great extent on their basic concepts of air transport operations, and both work without government subsidies and without state intervention in the conduct of business.

"In view of our past cordial relationships, it was only natural for Swissair and S.A.S. to attempt to find a more economic solution to the problem of changing over to jet equipment than either carrier would have been able to find alone. The result of our studies and negotiations, as approved by the boards of both airlines, may be summarized as follows:—

"Swissair and S.A.S., by the beginning of 1961, will each introduce three types of jet aircraft, namely the Douglas DC-8 for routes with particularly long stages and substantial traffic, the Convair 880 for routes with medium-length stages, and the Caravelle for the more important routes in Europe and the Mediterranean area. All aircraft of these three types will be completely standardized for both companies. Maintenance will be divided: S.A.S. will handle overhauling and certain periodic maintenance checks for Swissair's DC-8s and Caravelles, and Swissair will take on the corresponding work for S.A.S. Convair 880s. Swissair has ordered five Convair 880s costing a total of 173 million francs for planes, spares, special operational equipment and a flight simulator. Of these, Swissair is leasing two to S.A.S. for a period of four years. On the other hand, S.A.S. has ordered four additional Caravelles which will likewise be leased to Swissair for four years.

"Each carrier, in principle, will only need to purchase parts of the types of aircraft for which it does the maintenance work. To a considerable extent crew training will be carried on jointly. In every way possible, both carriers will also assist each other in engineering and operational matters. Hand in hand with this technical co-operation, both companies will continue to work together on the commercial side as in the past."

ALL DONE BY WIRES

OBSERVATIONS ON NORD AND VICKERS GUIDANCE TECHNIQUES

A tank and jeeps with SS.10 and SS.11 launchers at Camp de Mailly. Second from left (dark suit, sun-glasses) is Gen. Noel Daum, chairman of the technical board of Nord Aviation "Flight" photograph

EARLIER this summer the writer was invited to visit the Camp de Mailly in eastern France to watch a programme of SS.10 and SS.11 anti-tank missile firings arranged by Nord Aviation. Altogether 16 missiles of both types were fired from containers and zero-length launchers on the ground, from jeeps, trailers, an AMX tank and an Alouette helicopter. The targets were stripped-down tanks of various kinds which were driven across clearings on a heavily wooded firing range. All the shots were made by Nord's own operators.

A considerable number of invited guests came from NATO and SEATO, and from various other countries including South Africa, Japan and Venezuela. The French Air Ministry and the official export organizations were represented as well as Nord Aviation itself. Eleven countries have already adopted the SS.10 and SS.11, the latest being Norway and by the beginning of this year Nord had made 23,000 missiles for them.

Both the SS.10 and SS.11 have previously been described in detail in *Flight* (February 7 and November 14, 1958, respectively). Suffice it here to recall that the SS.10 flies at a constant 180 m.p.h. for a distance up to 1,500 m (4,900ft), is spin-stabilized and steered by offsetting the centre of vibration of four fluttering spoilers at the base of its four wings. An attitude reference is provided by a cordite-driven gyro and a single white flare in the tail makes the SS.10 easier to follow with the naked eye. The operator on the ground controls the missile with a miniature joystick connected to two potentiometers. Resulting electrical signals are passed along two fine, enamelled wires deployed from the missile itself in flight. The joystick control can be mounted on a small tripod which also holds a monocular telescopic sight for precise guidance towards the end of the flight. Batteries of missiles can be fired from one control post using appropriate selectors, and a controller can be removed some distance from the missile launcher.

Exactly the same control equipment is used for the SS.11, but this more advanced missile has a maximum range of 3,500 m (11,500ft), a flight time of 22 sec, and a flight speed which increases progressively from 248 to 425 m.p.h. The control system is again based on wire guidance, with a cordite gyro for stabilization, but control is by spoilers acting in the rocket exhaust. Two red flares are carried for visual tracking.

Although it was not shown at the Camp de Mailly, Nord are now developing the new SS.12, which is approximately twice as large as an SS.11 and employs radio-command guidance. An intriguing innovation is that control of the missile in flight can be handed from one operator to another.

On that baking hot day at Mailly, the spectators sat in a small grandstand to watch the missiles sizzling off into the shimmering heat haze several thousand yards up the range. The first demonstration was of the firing of inert SS.10s from their container/launchers at moving tanks 1,500 m away. After some difficulty over radio communication with the target tanks waiting to emerge from the woods, a reserve tank went out and started across the clearing. A blue-uniformed operator sat at his control box and at the chosen moment pressed the firing button. There was a dry pop from the missile as the cordite gyro spun-up, and then the little SS.10 leapt from its box with a brief bang and a flame and sizzled down the range. Rolling a jagged, zig-zag course, it went first up, then dropped, climbed again and dived into the dry grass, breaking up and bounding along for several seconds afterwards. Either the missile had malfunctioned, or the operator, as is often the case in such official demonstrations, was nervous. A reserve SS.10 was immediately selected and hissed away, surprisingly quiet and smokeless. In its weaving flight, the operator seemed to hold it about 10ft off the ground all the way. It flew on and on for about 20 sec, until its flare was almost out of sight, and then a puff of red dust denoted that its dummy warhead had hit the tank fairly and squarely in the middle.

The operators were evidently still nervous, for the third shot, this time at a moving tank at only 400 m range, was again driven into the ground some way short of the target. Three SS.10s mounted on a jeep were then brought up, the ramps being elevated by a hand-operated hydraulic pump. The jeep was pointed 30 deg off the line of fire, and the operator knelt on the passenger seat looking back over the steel blast-shield. Again the dry pop, and again the missile flew off and began to chase the tank creeping slowly across the clearing 1,500 m away. Tension mounted as the SS.10 fizzed along just a few feet above the ground, because the score so far was definitely in favour of the tanks. But this time the operator achieved a splendid hit and was rewarded with excited clapping from the grandstand. The control gear was then brought within the grandstand enclosure itself, well away from the jeep, and the operator achieved another fine hit on yet another tank moving across the clearing at 1,500 m. Things were getting hot for the tanks.

Before firing a series of SS.11s, the Nord spokesman explained that it had been calculated that the average crest-to-crest distance between hills in Europe was 3,000 m. Hence the design range of the SS.11. At 3,000 m it was extremely difficult to discern a tank slowly creeping across a different clearing, but the operator seemed to have no difficulty, using his monocular telescopic sight for the final part of the flight. The SS.11 was visibly faster and seemed a little more controllable than the SS.10. But the first round got into trouble when the wires broke and it suddenly dived sharply into the ground. A reserve shot on another zero-length launcher on the ground was immediately fired and achieved a hit which, even with the inert head, set the moving tank ablaze. There was a buzz of excitement in the grandstand, but either the tank crew escaped quickly or just sat and, literally, sweated it out for no one saw them get away.

As the distant horizon became obscured with smoke, the third SS.11 was loosed off at a moving tank at 600 m, close to the minimum range at which an average operator can achieve a hit. This SS.11 just found its mark, glancing off the glacis plate, somersaulting wildly for another hundred yards, and then starting a heath fire which soon spread a smoke screen right across the range.

An SS.11 was then fired from a battery of launchers mounted either side of the gun barrel of an AMX tank, with the operator inside the turret. At 2,000 m this, too, found its mark accurately despite the smoke after a long, very low flight. Further SS.11s were fired from jeep trailers on a line of fire 40 deg offset from the target. The operator brought the missile remarkably quickly into the line-of-sight between himself and the target. During succeeding firings direct hits became routine and the tanks were definitely getting the worst of the engagement.

The two most spectacular items were saved till last. An Alouette got airborne carrying two SS.11s on racks just aft of the cabin. First the pilot astonished everyone by playing hide-and-seek among the trees. Even though the spectators were on a hill the helicopter was out of sight for most of the time, and its progress could be followed only when it popped briefly up out of some fire lane, or from behind a clump of trees and shot off in a new direction. As an example of high-speed tactical manœuvring, it

ALL DONE BY WIRES . . .

was quite the most impressive demonstration I have yet seen. Painted a drab khaki, the machine itself was difficult to spot against the background of scorched grass and evergreen trees. It moved extremely quickly, made excellent use of the natural cover and would undoubtedly have made an extremely difficult target. Finally, it rose to about 100ft and, cruising along at about 50 kt, loosed off an SS.11 at a moving tank and achieved a most exciting direct hit. It then came to hover in front of the grandstand and dropped the long length of guiding wire which it had trailed across country for at least 1,000 yd. On its airborne launcher, the SS.11 is retained by an explosive bolt up to the moment of firing. The same launcher has been used on fixed-wing aircraft. A second SS.11 shot from the Alouette under similar conditions struck the ground some distance short of the tank.

Final item of the day's display was the firing of two live SS.11s with hollow charges against a wrecked tank at about 3,000 m range. They were fired one after the other from a jeep-towed trailer, and controlled by an operator sitting on the ground some yards away. Both shots were fine hits and produced brilliant flashes and splendid bangs.

Although Nord had not on this particular afternoon achieved their claimed hit-probability of 90 per cent, there had been only one certain malfunction, and at least a proportion of the misses could be put down to the traditional nervousness of an operator in front of a V.I.P. audience. Watching the missiles' flight as a pilot, I could easily sense the control movements the operators were making. It felt as if the SS.11 must be a little like a heavy aircraft to fly. The most difficult part seemed to be to keep the missile off the ground until it reached its mark.

Nord had a training simulator for the SS.10 and SS.11 working on their stand in the exhibition hall during the Paris Show, but when I went to try it it was suffering the endemic malaise of all machines of this kind; it was very unserviceable. I therefore went over to a similar device which Vickers-Armstrongs were exhibiting in connection with their Vigilant wire-guided anti-tank missile. This, too, was unserviceable, being plagued by an unstable local power supply which in all probability had affected the Nord simulator. I waited until it was working again and then tried my hand at "driving" an imaginary Vigilant.

Vigilant Tuition

The first immediate impression was that control of a Vigilant felt exactly as the flight of an actual SS.11 looked. In fact, the Vigilant corresponds fairly closely to the SS.11 in general characteristics, although the British weapon is a good deal smaller and carries a lighter charge. The simulator which I tried at Paris was an electronic analogue system produced by Vickers themselves and representing the most comprehensive form of training device available for the weapon. Simplified versions can also be had.

The principle was that the flight characteristics of the missile, modified by the control demands derived from a standard Vigilant hand-held guidance mechanism, were translated into the mechanical movement of a mirror, which deflected a spot of light on to the side walls and screen in a training building. The spot accurately represented the appearance of the marking flare in the tail of the Vigilant as it travelled away from the operator. A coloured, still photograph of scenery was projected on to the large screen about 20ft ahead of the projector and target silhouettes at representative ranges were superimposed on it. A ciné film with moving targets could also be used.

Three stages of simulation were available. Firstly, the movement of the spot of light over the surface of the screen could be directly coupled to the control lever to give the trainee operator initial experience of operating the guidance system. The picture was set to give the appearance of a firing position 29in off the ground. Secondly, half the aerodynamic losses could be introduced into the behaviour of the spot of light to provide an approximation of actual flight responses from the missile. Finally, the full losses could be applied and the full perspective effect of a receding missile was present. The purpose of the first stage was also to eliminate at the earliest possible moment any trainees who belonged to the estimated 5 per cent of the population whose left/right reactions are cross-coupled so that they operate a joystick type of control in the wrong sense.

Having introduced a new operator gradually to the flight characteristics of the missile, the instructor could then arrange for the spot of light to appear as if the missile had been fired from a sharply inclined ramp, from the left- or right-hand side or at a sharp angle to the desired line of fire. He could also introduce the effect of considerable cross-winds.

The control mechanism for the Vigilant is arranged rather like a tommy gun without a barrel, so that it can, if necessary, be grasped by its two pistol grips and held to the shoulder. A monocular or binocular sight is mounted on top of the assembly to facilitate aiming at long ranges in much the same way as one sights a telescopic rifle. The missile is fired by squeezing a normal trigger, and its path is controlled by a lever which engages the tip of the right thumb. The two potentiometers for vertical and lateral displacements are arranged on swivelling axes which correspond to those of the appropriate joints of an average thumb. The theory is that the average thumb has a suitable sensitivity, strength and range of movement, and is intuitively controlled with adequate precision. Being myself used to the classic joystick or wheel of an aeroplane, I found this thumb-type control a little strange at first, but the movements were very well accommodated to the natural freedom of my thumb. Adjustments for different thumbs or left-handed control can quickly be made.

An instant after firing an SS.10 from a French army jeep

Normally, a Vigilant operator will receive some six hours' training on the simulator, graduating from stage to stage up to the simulation of full aerodynamic losses and then becoming accustomed to the different launches, cross-wind effects, stationary and moving targets, and a wide variety of ranges. With flying experience to help me, I quite quickly got used to controlling the spot of light and found the most difficult part was to appreciate the increasing range between myself and the missile. This difficulty was also evident during the Nord firings. If, for example, half deflection of the thumb control produced a displacement of about 6ft across the screen immediately after firing, that same deflection and the same reaction would, at four times the range, appear as only a fraction of the original displacement.

Extremely fine control movements were required towards the end of the flight and, because of the apparent slowness of the response, it was possible for the thumb to get out of phase with the reactions of the missile at extreme ranges. Another difficulty was to appreciate the actual distance between the missile and the ground at the longer ranges. Although the missile could be flown along the straight line of sight between the eye and the target, it was safer to hold it slightly above the target and to bring it down only shortly before the strike. The monocular sight was of very considerable assistance in giving a more accurate appreciation of the distance to go between missile and target in the final seconds, but first the missile had to be gathered into the field of view of the telescopic sight when this was trained on the target.

There must be an ideal range at which the missile has come nicely under control, and the tension of a long flight has not yet made the operator inclined to over-control. Perhaps even more difficult than the long-range shot is the shot at minimum range, where there is very little time to settle down to smooth control, especially if the launcher is considerably offset. Although the missile is under full control immediately it leaves the launcher, some very accurate work is required to get it on target, without over-controlling and striking the ground, before the missile has passed the target. In the simulator the spot of light is locked with a loud click when the target's range is reached.

I was surprised that a strong cross-wind in which I made a couple of shots was fairly easy to counteract. The instructor told me that by the same token a moving target is rather easier to hit, because it feels more natural to keep the missile tracking at a steady rate across the scenery than to make it fly dead straight up to a stationary target.

As I have mentioned above, the Vigilant simulator felt just as an SS.11 looked. Accuracy seems to depend to a very large extent on the amount of practice an operator has recently had, but with thoroughly trained personnel a wire-guided missile is extremely flexible and can become a deadly weapon. Above all, it can pack the punch of an anti-tank gun and yet be carried about by a couple of men and conveniently hidden even behind a small bush. The Bofors Bantam, the smallest of the wire-guided missiles so far released, can even be fired from the hip.

C. M. L.

Royal Air Force Germany

SUSTAINING THE NATO SHIELD—Part 2*

By HUMPHREY WYNN

Air Marshal Sir Humphrey Edwardes Jones, Commander-in-Chief of the 2nd Allied Tactical Air Force and of R.A.F. Germany

LAARBRUCH airfield is a post-war one, cut out of a forest near the Dutch border and constructed by German labour in a year and a week. Three squadrons are based there—No. 5 (Meteor NF.11s), No. 16 (Canberra B(I).8s) and No. 31 (Canberras PR.7s)—and thus its operational equipment conforms to the three-type pattern of the Rhine area "clutch" airfields, i.e., all-weather fighter, light bomber and medium-range P.R. squadrons. Also based at Laarbruch is the R.A.F. Germany modification unit. As with the units at Gutersloh, there is divided operational control, Sector Operations Centre controlling the fighters and Tactical Operations Centre the bombers. There is also a division of control between R.A.F. Germany and 2nd A.T.A.F. as part of NATO. The airfield, that is the runway, dispersals and perimeter track, is a NATO base; domestic accommodation belongs to the R.A.F. As the station commander picturesquely put it: "The A.O.C. Germany gives directives for training; but as soon as the hooter goes he has no power and we come under NATO." He added that Laarbruch originally held a reconnaissance wing, with four squadrons; but under the policy of "not having all one's eggs in the same basket," squadrons of different types are maintained at each of the four clutch airfields. These have been constructed to a NATO pattern so that they can be used by all the Allied air forces. Standardization is maintained as far as possible, for example in fuel, AVTAG being in almost universal use at military airfields throughout Germany. In addition to the squadrons at Laarbruch there is an Army unit, No. 12 Air Formation Signals Regiment, which is responsible (like the G.P.O. in the United Kingdom) for landline communications; and a mobile field photographic section which works with No. 31 Sqn. in processing reconnaissance photographs. There are approximately 1,700 personnel at Laarbruch and plentiful recreational facilities are provided (as at other R.A.F. stations in Germany), including 17 football pitches and heated swimming pools, while there is a school for 440 children staffed by English teachers.

Air traffic control at Laarbruch presents some fairly complex problems, both from the pilots' and controllers' points of view. I.L.S. is being installed and so are crash-barriers similar to those in use at Gutersloh, thus increasing safety factors at the airfield; but geographically it is situated in a very busy airspace which demands the utmost vigilance from all concerned. There are the Dusseldorf and Hamburg airways and Dutch control centre in the vicinity, and squadron maps are marked with a complex of blue, orange, yellow and red patterns, indicating control zones, let-downs, low-flying and danger areas.

The perimeter track around the airfield is about ten miles long, so in an emergency all crews would live at their dispersals (a procedure which is practised during exercises). The operational rôles of the squadrons are clearly defined, though in No. 16's case variety is the keynote. Now equipped with the versatile Canberra B(I).8, the unit has had a mixed career since it was first formed from No. 5 Sqn. in 1915 for Army co-operation duties. It started the Second World War with Tiger Moths and ended it with Spitfires; it got its standard in 1956 and was disbanded in 1957, then re-formed on March 1 last year. Its functions now include high-level bombing, shallow bombing, toss-bombing using the LABS manœuvre and air-to-ground gunnery: thus the term "jack of all trades" is correctly applied to No. 16 Squadron's aircraft and crews, who are capable of performing these varied duties by day and by night. Approximately one-third of the unit's monthly flying total is made up of night hours; and at the time of our visit to the squadron it was reported that all the crews

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A Canberra B(I).8 of No. 88 Squadron, one of the light bomber units in 2nd A.T.A.F. and based at Wildenrath, flying over a German town in a setting reminiscent of Second World War operations

"Flight" photograph

Canberras of No. 16 Squadron at R.A.F. Laarbruch, with specially designed covers over the cockpit to stave off some of the heat of the sun. As an additional cooling aid in hot weather, cold air is injected for ten minutes before take-off

ROYAL AIR FORCE GERMANY . . .

except one were proficient in the LABS manœuvre (starting at 250ft and pulling up into a half loop then rolling out at 6,000ft) and all capable of high-level techniques. Low-level work apparently poses bigger problems and it takes some crews six months to get used to it. The aircraft can be adapted either for LABS or interdictor (with under-fuselage gun-pack) operations, and 25 per cent of the crews are always on standby, 50 per cent being within early calling distance. During the last big exercise, No. 16 Sqn. had all its aircraft off the ground in ten minutes.

The other Canberra squadron at Laarbruch is No. 31, operating PR.7s on photographic reconnaissance duties, at both low and high levels. In the former it supplements the work of the Swift squadrons, and it shares both rôles with Nos. 17 and 80 Squadrons, also equipped with PR.7s. Co-operating with No. 31 Sqn. at Laarbruch is No. 3 Mobile Field Photographic Squadron, which once a month takes its equipment out for a run to test mobility and keep in practice for its operational rôle. Judging by the photographic results displayed at No. 31 Sqn. headquarters, there is a high standard of P.R. work by the squadron and of processing by No. 3 M.F.P.S. in the increasingly important task of photographic reconnaissance—a rôle which, as the Commander-in-Chief remarked after the "Royal Flush IV" competition, was the original one undertaken by the R.F.C. in the First World War.

One of the famous numbers of R.F.C. squadrons, No. 5, was taken over last year by the all-weather fighter unit operating from Laarbruch with Meteor NF.11s. This present No. 5 Sqn. (the previous one was disbanded at Wunstorf in 1957) is conscious of its historic traditions and strives to maintain them proudly. It is one of two FAW squadrons in 2nd A.T.A.F. still mounted on Meteors (the other is at Geilenkirchen) but it is hoping soon to receive Javelins. Its function, broadly, is to maintain the night watch of the "battle flight" referred to earlier as one of the duties of the Hunter squadrons—a surveillance of the Air Defence Interception Zone—but in practice No. 5 Sqn. maintains a round-the-clock standby. Its interception capabilities are at present limited, though with right techniques and good controlling the Meteors have on occasion reached the V-bombers successfully and their serviceability rate is good, 99.5 per cent having been achieved during the last exercise.

Serviceability of the squadron aircraft at Laarbruch, as far as second-line servicing is concerned, is the responsibility of the Technical Wing. In the last exercise, this was maintained at almost 100 per cent; for on the final day, 41 out of 42 aircraft on the station were still flying—an excellent record. The Wing has ten officers and 1,100 airmen; its hangar is well equipped, with an overhead gantry and heating for wintertime; and an engine-change can be done in 2½ hours.

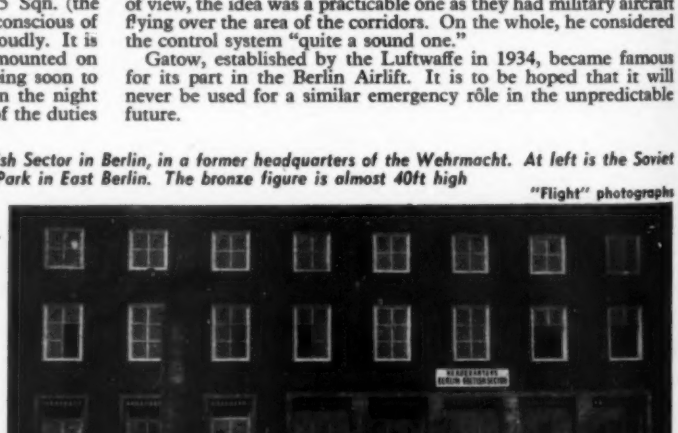
The Aircraft Modification Unit which was started experimentally in R.A.F. Germany a few years ago is based at Laarbruch and now works so successfully that it has almost certainly come to stay as part of the Command. Its function is to carry out modifications which previously would have necessitated aircraft being flown back to factories in the U.K. Normally the unit has up to 14 aircraft in its hangar, of five or six different types, and the same personnel work on all of them.

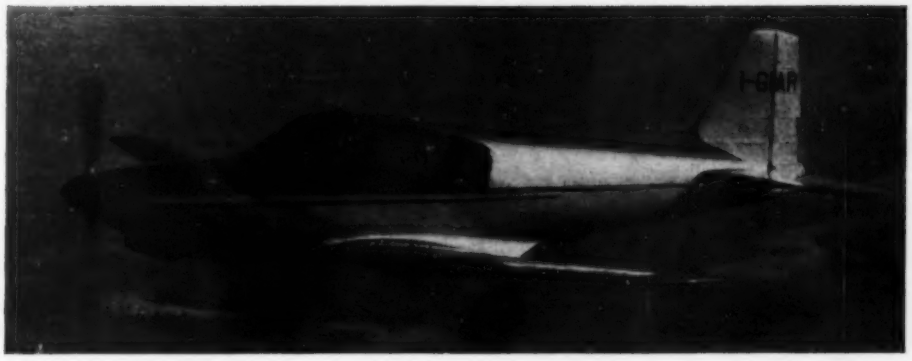
No description of R.A.F. activities in Germany would be complete without a reference to Berlin, where it maintains the airfield at Gatow and has a representative at the Air Safety Centre, the only surviving piece of four-power organization. This centre controls all air movements in the Berlin area (of 20 miles radius, up to 10,000ft) and in the three air corridors leading to Berlin from the West. The centre one, from Bückeburg, is 89 n.m. long; the northerly one, from Hamburg, 106 n.m.; and the southerly one, from Frankfurt, 160 n.m. Each is 20 miles wide. All movements in the northern and central corridors are handled by the R.A.F., and those in the southern one by the U.S.A.F. The A.S.C. itself, however, does not talk to aircraft in the corridors; that is done by Tempelhof, the Centre acting as a clearing-house for information on movements. There are about 100 scheduled services a day into and out of Berlin, and the British controller at the centre handles up to 80 movements a day. The A.S.C. provides the only Western link with the Russian air forces and the British controller, S/L. T. B. Nisbet, described the Russian officers with whom he worked (in co-operation with U.S.A.F. and French Air Force officers) as "very friendly." On the vexed question of the supposed 10,000ft upper height limit, he said that this had never been laid down; but what had become a practice became established in the Russian mind as a precept. From their point of view, the idea was a practicable one as they had military aircraft flying over the area of the corridors. On the whole, he considered the control system "quite a sound one."

Gatow, established by the Luftwaffe in 1934, became famous for its part in the Berlin Airlift. It is to be hoped that it will never be used for a similar emergency rôle in the unpredictable future.

In the right-hand picture is the headquarters of the British Sector in Berlin, in a former headquarters of the Wehrmacht. At left is the Soviet War Memorial in Treptow Park in East Berlin. The bronze figure is almost 40ft high

"Flight" photographs





"The Aviamilano Nibbio, the four-seat version of the sports-car-like Falco . . ."

By MARK LAMBERT

For Training and Touring

HANDLING THE MILES STUDENT AND THE AVIAMILANO NIBBIO

AN exceptionally fine summer has provided numerous opportunities for flying new types of aircraft in Britain and abroad, but the lengthy interruption caused by the printing dispute has hitherto allowed us no opportunity to record these interesting experiences. Here, however, are two of the reports prepared by Mark Lambert.

I HAVE long wanted to fly the Miles Student, but was not able to arrange it until recently I met Duncan McIntosh, the chief test pilot, early one morning at Le Bourget. We made a rapid external inspection of the aircraft in its new black and white colour scheme and then McIntosh and I climbed in through our respective car-type doors and strapped ourselves into the Folland seats with their back-type parachutes. A quick look round showed a single group of blind-flying instruments, including a G4.F gyro-magnetic compass, positioned in the centre of the panel. Running aft between the seats was a console holding a throttle lever, with airbrake lever close beside and undercarriage push-buttons within finger-tip reach of the throttle-open position. Undercarriage indicator and a clock were to the left of the main panel; to the right was a Plessey PTR.61 six-channel V.H.F. radio. Engine-starting and fuel-system controls, including tip-tank selectors and warning lights, were located on the console with a ground/flight switch in such a position that it could be quickly knocked on with a rearward push of either pilot's inboard elbow.

Starting procedure for the single Turboméca Marboré followed the standard non-automatic sequence of engaging the starter motor and then pressing the ignition button while the r.p.m. built up to the self-sustaining value. Automatic acceleration control was not yet provided, but engine handling was certainly no more difficult than that of a Derwent. In flight, a reduction in power produced the characteristic sudden reduction in thrust which I had already noticed in both the Morane Paris and the Fouga Magister. The control column was of characteristic Miles pattern, being curved considerably rearwards. I have found this arrangement very pleasant in *Flight*'s Gemini.

Toe-operated hydraulic brakes were fitted, but the Student could be manœuvred on the ground by using the nosewheel steering connected to the rudder pedals. Considerable effort was required, but precise control was available and tight turns could be made.

For take-off, we lowered a little flap and opened up to full power against the brakes. When the brakes were released, we were pushed firmly forward and the nosewheel was raised at 80 m.p.h. before flying-off at about 100 m.p.h. Although maximum speed for flap and undercarriage extension was 145 m.p.h., speed during retraction had to be held back to 120 m.p.h. because, on this first prototype, the wheel-door hinges were so aligned that the airstream prevented the doors closing at higher speeds. Trim changes with changes in configuration were slight, and could be easily cancelled by using the electrically operated elevator trim.

In cruising flight the Student soon showed the smooth handling characteristics which one has come to associate with Miles aircraft. Control in the three axes was well harmonized, and the anti-servo gearing on the fully balanced elevator had been reduced to a low value, though not so low as to encourage a pupil to get into trouble. Quite large rudder movements were needed to co-ordinate a reversal of the direction of turn, and longitudinal stability was very positive. Above all, the Student felt docile, and not in the least slippery. An instructor could get down to some serious teaching without worrying about exceeding limits or losing excessive altitude.

When the air-brake lever just below the throttle was moved back, the air-brakes extended slowly with progressive burbling, producing a slight nose-up trim change which became more positive at the higher speeds. When approaching the stall deceleration was steady, and the stall itself classic and viceless. In dirty configurations a wing tended to drop about 30 deg, but normal recovery action was immediately effective after only a slight loss of altitude.

Before returning to Le Bourget to make a quick circuit I did some straightforward aerobatics, rolling at 160 m.p.h. and looping at 240 m.p.h. Both manœuvres proved absolutely normal, a fair pull-force being required during the loop. A roll off the top also proved very simple.

The downwind leg and landing followed classic jet patterns, with very few checks to be made. Trim changes on lowering flaps and undercarriage just about cancelled each other out, and the final approach was made at about 105 m.p.h. with 19,000 r.p.m. The Student could be put down precisely on the runway on its main wheels, though the nosewheel had to be held up initially to avoid scorching the nosewheel tyre at over 80 m.p.h.

Altogether the Student is docile and simple to fly, and left me with an excellent impression of its general characteristics. It seems to offer a pleasant and simple introduction both to general flying and to jet operations.

* * *

HAVING already heard a good deal about the Aviamilano Nibbio, the four-seat version of the sports-car-like Falco, I was keen to fly it. The Italian demonstration pilot, Vico Rosaspina, brought Nibbio I-GIAR over to Paris and duly arranged for me to fly it one sunny evening. Four of us went up, myself as co-pilot, and my friend Jacques Noetinger, pilot and chief Press officer of the French U.S.I.A., as captain. Neither he nor I had ever flown the Nibbio, but Jacques and I have been in this kind of situation several times before.

The two passengers were ushered in through the single car-type door to starboard, over the finely polished and very thin wing.

". . . a pleasant and simple introduction both to general flying and to jet operations": the Miles Student flown by Mark Lambert
"Flight" photograph

For Training and Touring . . .

They ensconced themselves comfortably on the rear bench seat, and I followed Jacques into the front seats. The door was shut by a normal car-type lock at sill-level and an additional latch at the top. The seats were comfortable and there was plenty of leg room, with a "slit trench" for personal luggage behind the rear bench. Although there was obviously enough room for some hours' comfortable occupation, it felt as though the designer had originally taken four just-average people, sat them on low chairs and delineated round them the dimensions of a cabin which would touch them all at shoulder, head and hips. Next day I suggested this to Stelio Frati, the designer; he grinned broadly. After all, if he gave his clients 186 m.p.h. cruising speed on a single Lycoming 180 h.p. engine, he could not give them room for gymnastics as well. But Jacques, a six-footer with a permanently stiff left leg, was apparently at home.

A full blind-flying panel, including a remote-indicating compass and a standard range of engine instruments, is neatly laid out on the main panel with room to spare. On the left is a series of switches, covering the electrical system and operation from this source of undercarriage and flaps. A green light and tell-tales in the wings show the nosewheel undercarriage to be down, while a single red light shines whenever the wheels are up or in transit. Flap position is shown on a dial. Other levers control cabin and carburettor heat.

Elevator trim is applied by a winding handle in the ceiling and rudder trim by a small wheel on the floor. The standard Nibbio carries fuel in tanks fore and aft of the cabin and I-GIAR had a German Becker lightweight V.H.F. radio. The nosewheel is steerable and the hydraulic brakes on the main wheels are therefore operated together and a parking catch is provided. A single plunger throttle is centrally mounted, next to a large knob which is screwed in or out to set the constant-speed, Hartzell metal-bladed propeller.

From outside, the Nibbio's wing looks very smooth and thin: from inside the cabin it seems barely visible and certainly interferes less with downward vision than that of any other low-wing touring aircraft I know. The window arrangement is an admirable compromise between full visibility and shade, the latter being a most important requirement for any aircraft designed to operate in Mediterranean climates. Ventilation on the ground left something to be desired.

Following some notes made by Jacques, we started up the Lycoming O-360 and rolled to the take-off point. A touch of flap and a quick look round and Jacques raced off down the runway, unsticking smoothly at about 70 m.p.h. Gear and flap came in quickly and we rapidly built up speed and rate of climb. The Nibbio was quite obviously very fast and manœuvrable, easy to handle, noticeably quiet and comfortable. With this kind of aeroplane one can cover a great deal of country in very little time, enjoy the flight and still use small airfields. Settling at 2,400 r.p.m. and 23in intake pressure, we very soon built up and comfortably held 280 km/hr I.A.S. (175 m.p.h.) at about 1,500ft.

When I took control after a few minutes I found the Nibbio delightful to handle. It retains the classic responsiveness and smoothness of the Falco, but is less nervous. Lateral stability is neutral and the ailerons are slightly heavier than the other controls. By contrast the rudder is extremely light and, if kicked to one side and let go, the tail makes about one-and-a-half rapid oscillations and returns positively to centre. Longitudinal stability is good, a displacement resulting in one or two extremely slow oscillations without great variations in speed.

But the Nibbio gains speed very rapidly if the nose is lowered for any length of time. An inexperienced pilot would have to get used to this rather slippery performance. For the more experienced pilot the acceleration is exhilarating and highly satisfactory. Full aerobatics are permitted with two occupants, but this particular machine had only rudimentary lap-belts, and because of the full passenger load we contented ourselves with a few wing-overs and zooms. Vico Rosaspina later carried out most energetic aerobatics.

From the pilot's seat the wing of the Nibbio looks almost alarmingly small, yet the stalling speed is very respectably low, being well under 60 m.p.h. The stall itself is reported to be somewhat decided and, since we had little height and a full load, we decided not to try it during this flight, but I was assured that the stall is not vicious. Both Jacques and I flew the Nibbio for some time at about 90 m.p.h. and found no real deterioration of control. Response was naturally a little less crisp than at 170 m.p.h., but the handling retained its characteristic smoothness. Normal approach speed is 84 m.p.h., at which the flaps give a good glide-angle. Jacques made the landing, touching down at 68 m.p.h. in a quite normal attitude. The nosewheel went down gently and very little brake was needed during the short ground-run.

I am convinced that from the pilot's point of view the Nibbio is a real thoroughbred and a most useful touring aircraft. Later, in Italy, I saw several Falcos and Nibbios journeying between Sicily and the north, taking long sea crossings in their stride and putting up times far better than those achieved by any other single-engined touring aircraft in the locality. Rosaspina expected to fly straight across the Alps from Paris to Milan in 2½ hours. A Falco waltzed over the direct sea crossing from Naples to Palermo in just over an hour. A Nibbio won both legs of the Tour of Sicily race with speeds of 200 m.p.h. and 170 m.p.h.—the latter against 20 kt headwinds. That same Nibbio was at Paris during the show and had been flown to Beirut shortly before that. Aviamilano are now embarking on their second batch of ten Nibbios and the selling price is reported to be surprisingly low.

When I see how these lively Italian aeroplanes eat up the miles smoothly and comfortably I understand why the highly developed executive flying movement in the U.S.A. is constantly seeking higher and higher cruising speeds. In Britain we have no idea of such performance. The Nibbio's 186 m.p.h. at just over 21 m.p.g. makes nonsense of a 300-mile flight, and means so many fewer landings and attendant delays that 1,000 miles will slip by in a day, in two comfortable two-and-a-half-hour flights. One Falco is being imported into England and one can only hope that Nibbios will follow it.

AVIAMILANO F.14 NIBBIO

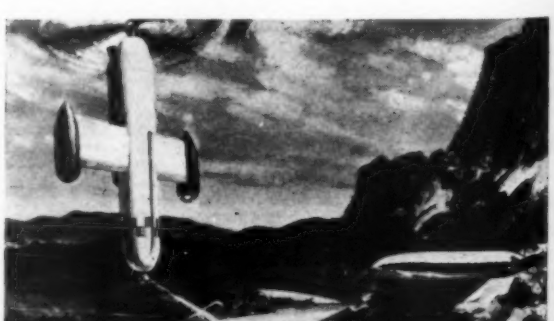
Lycoming O-360-A1A giving 180 h.p.

Span, 28ft 11in; length, 22ft 1in; wing area, 138 sq ft; empty weight, 1,496 lb; gross weight, 2,530 lb; wing loading, 18 lb/sq ft; power loading, 14 lb/h.p.; max. speed, 205 m.p.h.; normal and economical cruising speeds, respectively, 186 and 168 m.p.h.; stalling speed, 51 m.p.h.; take-off run, 590ft; range, 940 miles; service ceiling, 17,700ft.

FIRE-FIGHTING BY MISSILE

DESCRIBED by its sponsors—Solar Aircraft Company of San Diego—as a "missile-helicopter," a new device known as the Firefly is planned as a self contained fire-fighting vehicle which can be guided from the control tower of an airfield to the scene of an aircraft crash. As the illustration shows, the Firefly resembles a miniature jet aeroplane and flies under the thrust of a solid-fuel internal motor.

There are three distinct flight stages: ballistic trajectory; powered level flight and glide; and deceleration and hovering. Radio command and an airborne computer control the guidance system, and sensing devices on board the Firefly enable the operator to determine the location and severity of a fire, and how much extinguishing fluid to release. Once arrived at the scene of a fire (a range of five miles in 40 sec is quoted) the Firefly unlocks helicopter blades in its tail and hovers over the scene. At the appropriate point the operator can discharge more than a ton of extinguishing liquid. Span and length are both about 16ft (exclusive of rotors and extinguishant nozzles) and firing weight is about 5,000 lb. It is envisaged that one or more Fireflies would be located opposite the control tower near the runway in use, mounted on a launcher provided with a housing affording protection from the weather.



Correspondence

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. Names and addresses of writers, not for publication in detail, must in all cases accompany letters.

Croydon—Farewell and Thanks

CROYDON is about to close for ever. I feel there will be many who will wish to express their appreciation of the courteous and friendly treatment they have received for so many years from everybody there—the airport manager, the control officers, the Met, the Customs, the landing officers, briefing, and the marshals and porters.

I hope we may meet them again.

London, E.C.3. P. Q. REISS.

Pilot Utilization in B.E.A.

IN the review of the B.E.A. report and accounts for 1958-59, published in your August 28 issue, comment was made on the crew utilization rate for B.E.A. captains, "the average number of flying hours for each captain dropping from the low figure of 613 hours to a remarkably low 564 hours."

In order to correct any wrong impression that this comment might have given, I wish to point out that the average number of hours flown is hardly the correct yardstick to use in judging crew utilization rates. The average effective annual duty hours should be taken into account and from the report it is seen that there was an increase in this figure of 1.7 per cent. over 1957-58 in regard to captains.

The reasons for the reduced number of flying hours as against the increased number of duty hours fall roughly into three factors, as follows:—

(1) The increased use of faster aircraft in 1958-59, i.e., the flying hours of the Viscount 802 aircraft were doubled.

(2) The increased use of the flight simulators in lieu of flying training.

(3) The increase in the number of management posts filled by captains who were still holding pilots' contracts of service and for statistical purposes counted as active captains.

London, W.1. A. F. SHERMAN,
Assistant General Secretary,
British Air Line Pilots Association.

Hovercraft Curtains

WITH reference to Mr. D. Froud's idea (Correspondence, *Flight*, August 28) of using a curtain of water, instead of an air curtain, for marine applications of vehicles floating on an air cushion, we can inform you that we investigated this possibility some time ago. Experiments in our Laboratory for Internal Combustion Engines showed that this change gave a considerable gain.

We hope shortly to publish an article on the subject, with theoretical considerations. Most probably it will appear in the journal *De Ingenieur*.

Holland. ir. E. J. DIEHL, ir. P. VAN STAVEREN,
Delft Technological University.

To Honour and Remember

From the Rt. Hon. Viscount Knollys, G.C.M.G., M.B.E., D.F.C.

ONCE again, Battle of Britain Week [September 14-20] recalls to the nation the high price paid in 1940 and following years by those for whose present welfare and for those dependents the Royal Air Force Benevolent Fund exists. This year the Fund is 40 years old; during its four decades of work for members of the R.A.F., W.R.A.F., and their dependents in distress, the Fund has spent nearly £9 million.

Public support is continuously needed to carry this on at the present high level. We believe, moreover, that calls upon our resources are likely to increase as the multitude of veterans of the last war meet the problems that age brings.

To support this appeal, I think I can do no better than to quote the letter which we have received from Sir Winston Churchill, a vice-president since our foundation:—

"I am happy to send the Royal Air Force Benevolent Fund my good wishes on its 40th birthday. The Fund has given most worthy assistance to the dependents of those who served in the Royal Air Force. We should honour those who fought; we should remember the relations of those who fell."

I hope your readers will help the Fund to implement these obligations. All donations will be gratefully acknowledged by me at 67 Portland Place, London, W.1.

KNOLLYS,
Chairman of the Council, R.A.F. Benevolent Fund.

FORTHCOMING EVENTS

Sept. 19. International Spherical Balloon Concours, Zurich.
Sept. 20. British Gliding Association and London Gliding Club: National Glider Aerobatic Contest, Dunstable.
Sept. 23. R.Ae.S. Graduates' and Students' Section: Film Show.
Sept. 24-25. AGARD: Ninth General Assembly, Aachen.
Sept. 24-25. Aerodrome Owners' Association: Conference, Bristol.
Sept. 26-27. Genoa Aero Club: Rally.
Oct. 4-16. Seventh Anglo-American Aeronautical Conference, New York.
Oct. 6. IATA: Dr. Albert Plesman Memorial Lecture. "Supersonic Flight," by Hall L. Hibbard, at Delft, Netherlands.
Oct. 7. R.Ae.S. Graduates' and Students' Section: "Lunar Probes," by J. E. Allen.
Oct. 27. Radar and Electronics Association: "Electronics in Supersonic Flight," by F. W. Page.
Oct. 28. R.Ae.S. Graduates' and Students' Section: "Setting of Aircraft Specification," by R. H. Whitby.
Sept. 14-20. Battle of Britain Week.
Sept. 19-20. Popular Flying Association: Rally, Little Snoring, Norfolk (postponed from September 5-6).
Oct. 14. Society of Instrument Technology: "An Automatic Analogue Computer for Missile Homing Investigations."

Unrepresentative Collection?

DURING a recent visit to the aeronautical collection of the Science Museum we were struck by the historical inadequacy of the selection of models of aircraft of the Second World War. Only types of British origin are shown; consequently there are such important omissions as that of the world's first operational jet and rocket-propelled fighters—the Me262 and Me163. We suggest that, beside these, an instructive collection for the period should include at least the following types: the P-38, P-51, B-17 and B-29 (U.S.A.), the Il-10 and Pe-2 (U.S.S.R.), the Fw190, Me109 and Ju88 (Germany) and the Zero and Baka (Japan).

We understand that the museum's great difficulty is financial, and that it is compelled to rely largely upon donations. This seems to afford an excellent opportunity for public-spirited model-makers.

London, S.W.11. M. HAMMERTON, M. L. BURSTALL.

IN BRIEF

Commenting on "Registering the Famous," the R.Ae.S. list of historic aircraft (page 42, *Flight*, August 21) Mr. J. C. Bowman, of Pinner, supplies the number of the Fairey Swordfish at Lee-on-Solent; it is, he says, LS423, coded 5B.

Mr. B. K. Pegden is engaged on tracing the histories of British independent airlines, with particular reference to early post-war companies now defunct and to details of passenger and freight charters on contract work. He would be grateful for information; his address is 72 Oswald Road, Winton, Bournemouth, Hants.

WESTLAND TRIBUTE

LAST week we published a news-picture showing the presentation of an illuminated scroll to Mr. E. C. Wheeldon, managing director of Westland Aircraft, to mark the 21st anniversary of his joining the company. It is now possible to quote the verses from the scroll, which is decorated with drawings of ten famous Westland types:—

Whirlwind's might and Welkin's height
Were things he gave this land,
The Seafire too—and Barracu—
Right expertly were planned.

Nelson's shade in its astral glade
Bestirred and took good heed,
As Wyvern's grace and fighting pace
Rose to the Navy's need.

Future fears of future years
Were still-born at a stroke.
At United's side, Sikorsky's pride
Was harnessed to our yoke.

Soon Dragonfly and Widgeon spry
With five-one were aligned
And many more to swell the score—
Westminster, Wessex and Whirlwind.

A sturdy wight on its island bight
Was taken from its shelf—
To widen the field and increase the yield
Of the Nation's hovering wealth.

So much they've seen, those years between,
And now we wish him free
To give the lead to success indeed
With Future's Golden Key.

The address concludes: "With sincere congratulations from his colleagues and staff and with best wishes for the future."

SERVICE AVIATION

Royal Air Forces and Naval Flying News

Royally Commended

TWO awards announced last week were of the Queen's Commendation for Valuable Service in the Air to F/O. S. Toyne, for skill and courage in flying a Venom for 65 miles after it had caught fire at 34,000ft, then making a successful landing at Tengah (Malaya); and the Queen's Commendation for Brave Conduct to S. A/C. A. R. Mills, for gallantry in diving from an A.S.R. launch in an attempt to rescue a U.S.A.F. pilot.

Queensland Celebration

AIRCRAFT from the Royal Air Force and Royal Canadian Air Force are participating in the Queensland centenary celebrations in Australia, with visits to Brisbane and displays there and over other principal cities.

The R.A.F. is represented by three Valiants of Bomber Command, supported by a Comet 2 and a Hastings of Transport Command. The detachment is led by A.V-M. M. H. Dwyer, A.O.C. No. 3 Group, and is being joined by a Britannia of 99 Sqn., on a proving flight to Australia, and a Beverley from F.E.A.F. The Valiants are from No. 49 Sqn., the Comet from No. 216 Sqn. and the Hastings from No. 36 Sqn. The detachment is due to return to the U.K. on October 9.

The R.C.A.F. is being represented by two Argus aircraft of Maritime Air Command which are making a month-long tour of Australia and New Zealand. The Canadian detachment is under the command of G/C. J. H. Roberts.

Gen. Leon W. Johnson, U.S.A.F. (right), Air Deputy to the Supreme Allied Commander Europe, presenting the Guynemer Trophy to F/L. R. McGarva, leader of the R.C.A.F. team which won the AIRCENT air firing competition at Cazaux recently (this page, last week)

"Flight" photograph

To be employed by carrier task forces to extend the range of their defence radar system—the Fairey Gannet AEW.3, powered with a Bristol Siddeley Double Mamba ASMD.8 turboprop

The annual general meeting of the R.A.F. Reserves Club will be held on Thursday, October 1, at 6.30 p.m. in the club house, 14 South Street, Park Lane, London, W.1.

* * *

The Marine Craft Squadron at Seletar, Singapore, has been awarded the Far East Marine Craft Trophy for general efficiency. This is the third time the squadron have won this trophy.

* * *

A new tie which has been designed for No. 6 Squadron, bearing the famous "flying can-opener" emblem, can be obtained by past and present aircrew members from the Adjutant, No. 6 Squadron, R.A.F. Akrotiri, B.F.P.O. 53, price 18s 6d.

* * *

S/L. Roland Burton, who as a flight lieutenant won the England - New Zealand air race in 1953, has been awarded £225 by the Committee on Awards to Inventors for his invention of the first photographic reconnaissance sight for operational flying to be used in the Royal Air Force. Known as the P.R. Sight Type I, it solves the problems which arise in photographic reconnaissance with the introduction of faster aircraft. S/L. Burton, who retired from the R.A.F. last year and has been flying with Hunting Aero Surveys, designed the sight while serving at R.A.F. Benson and its prototype was used in a Mosquito of No. 540 Squadron.

* * *

The sale of Pocklington airfield in East Yorkshire, from which R.C.A.F. Halifaxes operated during the war, realized £33,250 at a recent auction.

* * *

A history of No. 51 Sqn. is being compiled, and any ex-members who can provide relevant information or photographs are asked to communicate with F/L. J. A. Brothers, No. 51 Squadron, Royal Air Force, Watton, Thetford, Norfolk.

* * *

There is to be an interchange of command next month between two R.N.Z.A.F. transport squadrons. S/L. G. H. S. Tosland, the C.O. of No. 41 Sqn. at Singapore, is returning home to New Zealand and will there assume command of No. 40 Sqn. He succeeds S/L. O. D. Staple, who on October 3 takes over No. 41 Sqn., the only Bristol Freighter unit in F.E.A.F. No. 40 is a long-range squadron, equipped with Hastings and operating between New Zealand and Singapore.

X